

Pit and Quarry

Member
Audit Bureau of
Circulations

With which is consolidated
**CEMENT-MILL
& QUARRY**

Read in
Largest Number
of Plants

Vol. XXIII

CHICAGO, FEBRUARY 24, 1932

No. 11

To Install Stokers on Cement Freighter

JOHN AGAIN HEADS PETOSKEY

The board of directors of the Petoskey Portland Cement Co. re-elected its officers for 1932 at the annual meeting held recently. These include: President, J. B. John, Cleveland; vice-presidents, Homer Sly, Petoskey; J. C. Buckbee, Chicago; Herman M. Magnus, Cincinnati; secretary, Emory O. Nyman; treasurer and general manager, John L. A. Galster.

The Petoskey Transportation Co. stockholders and directors met also. The stockholders heard reports of the shipping of bulk cement aboard the freighter *J. B. John*, and voted to install automatic stokers on the ship. Work will start about March 1. This improvement will make the ship more modern and tend toward more economical operation. George W. John and Herman M. Magnus were re-elected directors.

At the directors' meeting of the transport subsidiary the officers re-elected included: President, J. B. John; vice-presidents, Homer Sly, J. C. Buckbee, Herman Magnus and H. H. Lucas; secretary, Emory O. Nyman, and treasurer and general manager, John L. A. Galster.

Maine Cement Plant to Open Up Another Quarry

Extension of the quarry at the Thomaston, Me., plant of the Lawrence Portland Cement Co. is being started, according to Carl H. Sonntag, superintendent. The new operations will be located on the opposite side of the main highway and will be reached by tunneling under the road. Frank H. Smith, president, recently visited the Thomaston operations.

Purchases Pennsylvania Silica-Sand Operations

Arthur T. Harris, of Honey Brook, Pa., has purchased the Budding Silica Sand Mines on Welsh Mountain about two miles west of Honey Brook and will operate them as in years past. The mines for a number of years had been owned by the late J. C. Budding,

of Lancaster, Pa. Mr. Harris purchased all equipment on the grounds and has leased the acreage.

Mr. Harris had been general manager of the operations for the Budding company for the past 20 years. Operations were started years ago on the same site by the Diller Sand Co., now out of existence.

Speed Up Work at New Plant on Hudson River

A second shift of workmen has been established at the Mount Taurus quarry and trap-rock plant of the Hudson River Stone Corp. now under construction on the Hudson River near the Bear Mountain Highway Bridge at Cold Spring, N. Y. Additional machinery has arrived and construction of several more buildings will be begun shortly.

Arkansas Quarries and Pits Increase Payrolls

The sand-and-gravel and crushed-stone industries of Arkansas showed increased activity during the month of January, according to the report of W. A. Rooksbery, state labor commissioner.

These industries showed a 72-per cent. gain in the number of workers employed over the preceding month and a 34-per cent. increase in payrolls.

Fire Causes Damage at Plant Near Peru, Ind.

Fire of undetermined origin destroyed the building housing the boiler and steam engine at the plant of the J. J. O'Connor & Sons Sand and Gravel Co. located near Peru, Ind., recently.

The loss will amount to several thousand dollars, it is reported.

Better Business Outlook Seen by Vermont Quarry

Improvement in the outlook for future business was expressed at the annual meeting of Presbrey-Leland Quarries, Inc., held recently at Brattleboro, Vt. C. H. Presbrey was re-elected president as were the other officers and directors of the concern.

Big-Scale Financing for Homes Predicted

DEALERS HEAR SEWELL AVERY

Sewell L. Avery, president of United States Gypsum Co. of Chicago, in address before Illinois Lumber & Material Dealers' Assn., stated that in the future homes would be bought by specification from dealers who would not only furnish materials but would also arrange all details including financing and service. In this respect future home buying will be similar to purchasing an automobile from a dealer who sells by specification and arranges everything for the buyer including service and financing, he said.

While unit home selling by the mail-order houses forms an improvement over former methods, the material dealers are in a better position to combine with their material business the details of construction, financing and service which are not now available on a unified basis to any large extent, Mr. Avery stated. In his estimation, the major accomplishment of the mail-order houses in this industry was the development of a finance plan.

To carry out such large scale operations, Mr. Avery indicated that it would be necessary for the small building dealers to get together and form large enough companies to handle the situation economically.

Manitowoc Cement Plant Closes Down for Season

The Manitowoc Portland Cement Co. has closed its plant at Manitowoc, Wis., for the season. Shipments for several months will be made from large stocks which remain on hand. During the closed period numerous improvements are to be made, according to company officials.

Indiana Gravel Concern Wins County Contracts

The Koch Sand & Gravel Co. of Evansville, Ind., has been awarded the bulk of the contracts for supplying gravel for road work in Posey County during the coming season.

The bids ranged from \$1.00 to \$2.18 per cu.yd., depending upon the length of haul.

New Construction at Low Ebb in January

CONTRACTS TOTAL \$84,798,400

A low construction contract total for January is reported in the 37 states east of the Rockies, but statisticians of the F. W. Dodge Corp. do not find the \$84,798,400 total for the month surprising in view of the retarding influences at work in this as in all businesses.

Of this \$84,798,400 total, \$27,504,300 was in residential building; \$33,237,700 was in non-residential building; and \$24,056,400 was in public works and utilities contracts. The marked decline in this latter class is, to quote the bulletin, "closely tied up with the current wave of budget-cutting on the part of municipalities and other public bodies. While this has a depressing effect on current operations, it is actually one of the last steps in the long chain of cost deflation, debt deflation, and real estate deflation that the country has had to undergo. Since it appears necessary to go through these disagreeable operations, it is best to consider the process much as a dose of medicine, the sooner taken the better the patient's chances for recovery."

In the various districts comprising the 37 states in the Dodge territory, the largest total, although low when compared with previous Januarys was that for Metropolitan New York where \$20,436,800 in construction contracts was reported during the month. Contracts amounted to \$12,955,800 in the Middle Atlantic States.

New England and the section known as the Pittsburgh territory (Western Pennsylvania, West Virginia, Ohio, and Kentucky) were nearly even with \$7,589,200 reported in the first named and \$7,517,600 in the latter. In both the Kansas City territory (Western Missouri, Kansas, Oklahoma, and Nebraska) and in the St. Louis district a total of somewhat over \$4,000,000 was reported. The St. Louis territory is composed of Southern Illinois, Eastern Missouri, Northeast Arkansas, Western Tennessee, and Northwest Mississippi.

Marquette Cement Given 2,500,000-Barrel Order

A single order totaling 2,500,000 barrels of cement, the largest ever awarded in the middle west for delivery in 12 months, has been received by the Marquette Cement Manufacturing company from the Illinois department of public works and buildings. This announcement was made by Mr. Theodore G. Dickinson, president, who also stated that it is the largest order ever received by his organization or probably any other in the cement industry.

BUILDING-MATERIAL PRICES, JANUARY 1, 1932

Data collected by the Bureau of the Census and prepared by the Division of Building and Housing, U. S. Bureau of Standards.

City	Portland Cement (bbl.)	Gypsum Plaster (ton)	Gypsum Plaster Board (1,000 sq. ft.)	Hydrated Lime (ton)	Building Sand (cu. yd.)	Crushed Stone (ton)	Roofing Slate (100 sq. ft.)
Akron, O.	\$1.74	\$14.00	\$.....	\$12.00	\$1.50	\$2.50	\$12.00
Albany, N. Y.	2.34	16.20	23.85	15.75	.....	.....	.....
Atlanta, Ga.	2.50	19.75	.....	15.00	2.81	2.50	.....
Baltimore, Md.	2.10	15.50	25.00	13.00	1.85	2.50	10.00
Buffalo, N. Y.	2.95	16.00	21.00	18.00	2.50	2.05	12.00
Chicago, Ill.	1.55	.....	20.00	12.50	1.75	2.00	.....
Cincinnati, O.	1.94	.....	22.75	14.40	2.63	2.55	.....
Cleveland, O.	2.00	15.00	22.00	10.00	1.69	2.15	16.00
Columbia, S. C.	2.28	15.40	35.00	.....	1.50	2.60	14.00
Columbus, O.	2.35	14.40	.....	12.00	1.50	2.75	14.00
Des Moines, Iowa.	1.82	14.00	23.50	18.00	1.40	4.15	15.00
Detroit, Mich.	2.00	15.00	25.00	12.00	2.03	1.75	.....
Erie, Pa.	2.10	16.00	22.50	16.00	2.00	.....	.....
Fairmont, W. Va.	2.75	18.00	35.00	16.00	2.80	3.50	13.00
Grand Forks, N. D.	2.60	18.75	.....	16.25	2.60	.....	.....
Haverhill, Mass.	2.32	18.50	25.00	18.00	.....	.....	.....
Kansas City, Mo.	2.08	15.00	25.00	22.00	1.65	2.25	16.00
Lansing, Mich.	2.25	17.50	.....	.....	1.80	1.80	.....
Los Angeles, Cal.	2.30	15.20	23.50	24.70	1.85	1.90	.....
Louisville, Ky.	1.86	17.00	.....	15.00	2.00	2.15	.....
Milwaukee, Wis.	1.25	15.20	22.00	14.00	1.25	1.25	.....
New Bedford, Mass.	2.40	16.50	24.00	16.50	1.50	2.75	.....
New Haven, Conn.	2.90	.....	.....	20.00	1.25	2.25	.....
New London, Conn.	2.60	18.00	25.00	18.00	1.50	3.00	.....
New Orleans, La.	2.35	18.00	.....	14.00	1.85	.....	11.00
Paterson, N. J.	2.20	17.50	24.00	18.00	1.50	2.10	12.00
Philadelphia, Pa.	2.10	17.50	.....	13.73	1.75	2.60	11.22
Poughkeepsie, N. Y.	1.95	13.00	.....	.....	2.25	.....	.....
Richmond, Va.	2.90	18.00	.....	21.00	1.65	2.10	10.50
Rochester, N. Y.	2.28	16.00	22.00	20.00	2.25	2.40	12.00
St. Louis, Mo.	2.00	16.00	.....	16.00	1.35	1.65	12.00
St. Paul, Minn.	2.15	17.00	21.00	19.00	1.25	1.75	11.50
Saginaw, Mich.	1.85	18.00	25.00	16.00	2.25	2.20	14.00
San Antonio, Tex.	2.42	17.00	42.00	20.00	2.15	2.35	16.50
San Francisco, Cal.	2.54	17.30	45.00	22.50	1.40	1.40	14.00
Savannah, Ga.	2.35	16.50	27.50	21.50	1.75	3.50	14.00
Scranton, Pa.	2.40	19.90	.....	20.00	4.39	.....	.....
Seattle, Wash.	2.40	18.00	35.00	22.00	1.40	1.50	.....
Shreveport, La.	3.00	20.00	38.00	.....	2.00	3.20	18.50
Sioux Falls, Ia.	2.60	15.00	40.00	22.00	1.25	2.00	.....
Syracuse, N. Y.	2.60	14.00	20.00	.....	1.80	1.60	8.00
Tampa, Fla.	2.60	.....	.....	24.00	2.75	2.80	.....
Terre Haute, Ind.	2.00	18.00	28.00	18.00	1.25	3.00	13.25
Toledo, O.	1.40	14.00	21.00	12.00	1.60	1.75	.....
Trenton, N. J.	2.10	17.00	23.00	18.00	.90	1.05	9.80
Tucson, Ariz.	3.49	17.10	45.00	30.00	1.25	2.25	.....
Tulsa, Okla.	1.90	16.00	22.50	22.50	.85	2.35	.....
Washington, D. C.	1.65	14.00	25.00	12.00	.....	.....	.....
Waterbury, Conn.	2.60	20.00	30.00	20.00	1.25	2.45	15.00
Wichita, Kan.	1.75	15.50	25.00	22.50	1.00	.....	.....
Youngstown, Ohio	2.43	18.00	23.25	16.00	2.50	2.50	14.00

Utah Plaster Plant to be Rebuilt Immediately

Work is already underway on the rebuilding of the plant of the Jumbo Plaster & Cement Co. at Sigurd, Utah which was destroyed by fire recently.

A salvage crew began going over the ruins a day or so after the blaze occurred and officials of the company decided on a program of immediate construction on account of the large number of orders on hand.

Erie Stone Company to Install New Equipment

Plans are underway for extensive remodeling and the addition of much new machinery at the plant of the Erie Stone Co. located near Huntington, Ind. The company operates three other plants in the Hoosier state, most of its crushed-stone output being sold as railway ballast and for road work.

Cement-Plant Workmen Honor Thos. J. Quigley

Following a safety rally celebrating a 100-day working period without a lost-time accident, workers at the

Nazareth Cement Co. plant at Nazareth, Pa., formed a safety organization to be known as the Thomas J. Quigley Honor Society. The club takes its name from the head of Pennsylvania's Department of Labor and Industry who has been one of the country's most ardent proponents of the movement for safety in industry.

Fred Hunt, chairman of the safety committee at the plant, presided at the rally. Besides the guest of honor, Mr. Quigley, A. J. Reichenbach, superintendent of the Nazareth plant and C. P. Lynch, safety inspector, gave talks.

Superior Cement Awards Prizes for Best Essays

For several years Superior Portland Cement, Inc., of Concrete, Wash., as part of its plant safety campaign, has offered prizes to school children for the best essays on safety. This year the subject was "Safety First in the Storage, Packing and Shipping Departments". Strangely enough, first prize in the high-school and grammar-grade divisions went to a brother and sister, Lawrence and Alice Cunningham.

The winning essays were read at the February safety rally at the plant.

WEEKLY BUSINESS INDICATORS

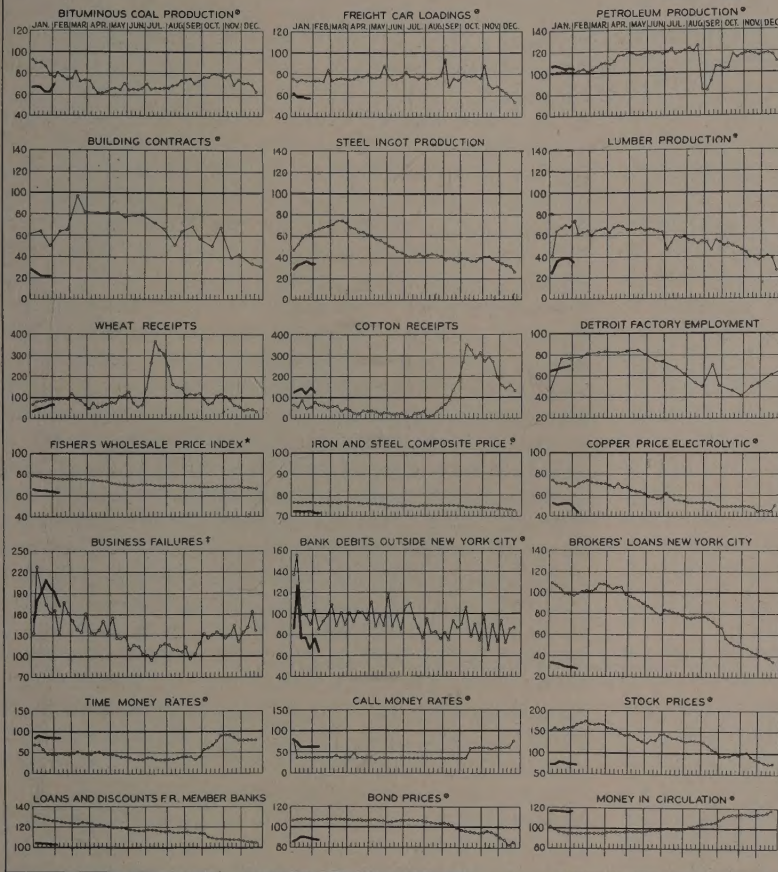
SURVEY OF CURRENT BUSINESS

UNITED STATES DEPARTMENT OF COMMERCE

DATA PLOTTED, WHERE AVAILABLE FOR WEEK ENDING FEBRUARY 13, 1932
WEEKLY AVERAGE, 1923-1925, INCLUSIVE = 100

LEGEND

1931
1932



* DAILY AVERAGE * RELATIVE TO 1923-1925 * NUMBER * RELATION TO WEEKLY AVERAGES 1923-1925 PER WEEK SHOWN

Zanesville Gravel Firm Acquires Dredge 'Snipe'

The Muskingum River Sand & Gravel Co. of Zanesville, O., has purchased the dredge *Snipe* from the Allegheny River Sand Corp. of Pittsburgh. The vessel was recently rebuilt at Parkersburg, W. Va., shipyards, the purchase price being in the neighborhood of \$24,000, according to reports. The *Snipe* is said to have a capacity of 1,000 tons daily and is 120 ft. long and 34 ft. wide. It will be put in service during the coming season on the Muskingum River by its new owners.

Crushed-Stone Plant in Texas Destroyed by Fire

Fire of unknown origin practically destroyed the Salesville, Tex., plant of the Mineral Wells Crushed Stone Co. of Mineral Wells, Tex., early this month. The loss was partially covered by insurance. The plant was originally erected in 1912 at a cost of nearly \$35,000 but numerous improve-

ments have been made since that time. Officers of the company are W. I. Smith, president; George P. Maury, vice-president and general manager; and George M. Ritchie, secretary-treasurer.

Lets \$100,000 Contract for New Drying Plant

The Standard Silica Co. of Ottawa, Ill., has awarded a contract to the McClintic-Marshall Corp. of Chicago, for the construction of a new \$100,000 drying plant to replace its previous plant destroyed by fire last October.

The new structure is to be fireproof, steel and reinforced concrete being used in its construction. Fifty-foot concrete bins will form the foundation.

Silica-Sand Firm Head Sees Better Business

Business is certain to take a turn for the better this year, in the opinion of William S. Walker, president of the American Silica Sand Co. of Ottawa, Ill., who recently returned from a trip through the eastern states.

Marble Firm Installs Teletypewriter Service

AIDS OFFICE COMMUNICATION

Communication between the home office of the Vermont Marble Co. at Proctor, Vt., and several of its eastern branches will be facilitated by the installation of the teletypewriter service of the American Telephone & Telegraph Co. Teletype machines are being installed in Proctor, the Swanton plant, the New York Drafting Annex, and in the Boston, New York and Philadelphia branch offices. Each machine will be connected with the telephone company's local central office where switching devices will enable special operators to make connections in the same way that long-distance calls are handled.

In addition to permitting teletyped messages from one branch to another, the service will enable the Vermont Marble Co. to communicate direct with large concerns throughout the country that are using the same service.

Concrete Products Assn. of Wisconsin Convenes

The eleventh annual convention of the Wisconsin Concrete Products Assn. was held Thursday and Friday, Jan. 28 and 29, at the Hotel Plankinton, Milwaukee.

Speakers on the program included W. D. M. Allan, manager of the Cement Products Bureau of the Portland Cement Assn., Eugene F. Olson of Alpena, Mich.; H. C. Shields, Buffalo, N. Y.; and O. T. Nelson of the Wisconsin Industrial Commission.

A. S. T. M. Committees to Gather at Cleveland

The standing committees of the American Society for Testing Materials will hold their annual Spring Group Meetings in Cleveland, beginning Monday, March 7 and extending through Friday, March 11. Among the committees will be Committee C-7 on Lime and Committee C-9 on Concrete Aggregates. In conjunction with these is the third Regional Meeting sponsored by the Society, which will be held on Wednesday, March 9.

Miller Re-elected Head of American Gypsum Co.

The American Gypsum Co. of Port Clinton, O., at its recent annual meeting chose the following directors for 1932: John A. Kling, Charles Miller, John D. Kling and J. B. Davis, Cleveland; Howard McCrady and John Bennis, Braddock, Pa.; P. K. Tadsen, Port Clinton.

Officers were re-elected as follows: Charles Miller, president; Howard McCrady, vice-president; J. B. Davis, secretary and treasurer, and John A. Kling, chairman of the board.

Editorial

Wages and Prosperity

EXCEPT for a small minority which is opposed to prosperity on account of the facility it provides for the enjoyment of luxuries, everybody is awaiting the return of so-called "good times." While this undoubtedly expresses the common wish and while many business men have ceased wishing for prosperity and have turned to a discussion of ways of creating it, there is still too much reliance on quack remedies and attractive panaceas. The reduction of the wages of railroad employees, for example, is one of the many steps held essential to business recovery, yet we believe it is one of the most delusive of proposed remedies. How reduction in the earning power—and the reduction in purchasing power that naturally follows it—can result in an improvement in business is difficult to see. The present troubles of business are due to the curtailment of buying, so it would seem logical that the revival of buying would be accomplished most quickly and most materially by increasing the public's buying power. Certainly this end is not attained through reduction of the buying power of many hundreds of thousands of families.

The belief that the reduction of railway workers' wages, for example, will in some mysterious way stimulate business arises from the theory that the business of the country is supported by those who control large amounts of capital—the capitalists, in short. If they withhold their capital from the development of new enterprises and from the expansion of old, it is said, business not only can not increase but it can not even maintain an even pace. Wholly aside from the obvious fact that the country does not now—and probably will not for some time to come—require any expansion of its existing production facilities in any important field and that, therefore, no large amounts of capital are needed for that purpose, it is not even partially true that the prosperity of the country depends upon the caprice of capital or the seeming or genuine returns which it can obtain from business. The capitalists of the country represent but a small portion of the population numerically and only a slightly larger portion of the population's buying power, therefore the country's prosperity can not be actually dependent upon what this small group does. The buying which business so badly needs will be done by the millions of workers and not by the thousands of capitalists, by those whose consuming power far transcends that of the smaller group. The problem of improving business is, therefore, one of increasing the purchasing power of the multitude rather than that of the minority. General business lives out of the necessities of the majority, not out of the luxuries of the minority.

Were this truth more generally recognized, there would probably be more concern about maintaining wages than about maintaining dividends, however

important the latter appear to be at the moment. It would seem to be wiser for business to reduce dividends than to lower wages, since lower dividends do not have the same devastating effect on commodity sales—which are the life of business—as do lower wages. Every reduction in the wages of the large body of workers cuts immediately into buying power and reduces the consumption of those articles whose production and sale support business. Reductions in dividends, on the other hand, have little general effect in reducing buying power, principally because they affect a small minority of the population and, secondarily, because they do not cut into the consumption of the necessities of life. Those who live on the returns from investments are, for the most part, those who have accumulated surplus earnings which have been turned back into industry to increase production facilities and, in general, they may be presumed to have more than enough income, even in these times, to provide sustenance. The great majority of our wage earners, however, never accumulate a surplus, so that any reduction in earning capacity—whether through reduced wages or reduced employment—calls for immediate economy and even skimping in order to provide bodily sustenance. Of course, there are many who, although living out of so-called unearned income, have no surplus of income over expenditure and who, therefore, find themselves in exactly the same position as the worker whose bare living is impaired through income reduction. Fortunately, however, they form but a small portion of the population.

In considering whether dividends or wages should be reduced it is good to realize that reductions in dividends cause temporary inconvenience to those who depend on them for their living but do not have any material effect on the widespread consuming power that supports industry. Furthermore, maintenance of wages, even when accomplished at the cost of sacrificing dividends, sustains this consuming power and, therefore, hastens the arrival of the time when normal dividends can be resumed on account of the profits derivable from a well-sustained consuming demand. Maintaining dividends at the expense of wages certainly affords immediate protection to stockholders, but it just as certainly jeopardizes their future dividend-receiving capacity. It is impossible to make for any considerable length of time consistent dividend payments out of a business that experiences a continually declining sale for its products, and it is impossible to maintain a continuous consuming demand—and, as a result, a continuous profit-earning business—by reducing wages and resulting consuming power. The question seems to be whether stockholders are willing to waive their profits for a time—surely many of them have been forced to do so—in order to insure their certainty in the future, or whether they will

insist on their dividends now and take their chances of losing them in the future.

There is no humanitarian point whatever to this view of the matter. The considerations stated are those of self-interest, unqualified by any social point of view. We are trying to look at the problem from a strictly business standpoint. Is it best to maintain dividends and reduce wages, and so, maintain the luxury-consuming power of the minority while seriously impairing the necessary-consuming power of the great majority and, as a result, make certain the failure of dividends in the near future? Or, is it perhaps not wiser to maintain wages and reduce or pass dividends, and, so, maintain the necessary-consuming power which sustains business and, as a result, insure the security of dividends in the near future? In brief, as a problem in economics, is it not better for business generally to adopt those policies—such as maintaining wages, even, if necessary, at a sacrifice of dividends—that defer for a time the enjoyment by the minority of those luxuries and surplus comforts (whose production supports only a small portion of business) but make immediately available to the great majority those necessities of life (whose production supports the major portion of business)? And is it not worse for business generally to adopt the opposite policy—maintaining dividends, even, if necessary, at a

sacrifice of wages—of providing immediate enjoyment of the luxuries by the few who support only a small portion of business while withholding from the great majority, which supports the major portion of business, those things which are essential to physical well-being? Since business thrives on the necessary-buying power of the multitude and not on the luxury-buying power of the minority, why should not it adopt those policies, such as the maintenance of wages, which maintain that necessary-buying power in a state of healthy activity and, so, guarantee to the minority that surplus of earnings in dividend form which gives it its luxury-buying power?

The 10-per cent. reduction in the wages of railroad workers affects 1,500,000 men and their families, a total of 7,500,000 people, whose buying power, already insufficient to provide more than the necessities of life, has been sharply curtailed. This curtailment, amounting to \$210,000,000, will come in that part of general consuming power which affects all industry. The average railroad worker's family will spend roughly \$200 less in the coming year. It is difficult to see just how this will help general business, either through increasing the buying power of the 7,500,000 people who are affected or through stimulating those who may have some hoarded savings to dip into them for the sake of improving the general situation.

New Committee of A. S. T. M. to Study Mortars for Masonry

A new standing committee of the American Society for Testing Materials has been organized to undertake work in the field of mortars for unit masonry. This committee which has been designated C-12 on Mortars for Unit Masonry has the following scope:

"Research to promote knowledge of properties and tests of mortars for unit masonry and development of methods of test and specifications for such mortars. It is intended that the activities of the committee shall be closely correlated with other interested committees of the Society."

At a meeting held last June, organization was effected with temporary officers and a temporary advisory committee which have continued to function during the past few months in the completion of the personnel of the committee and in the development of a subcommittee organization.

While tremendous strides have been made in the knowledge and use of mortars in the thousands of years during which they have been used, there is still a great deal to be learned about the various types. This subject is an important one and many millions of dollars are expended annually for structures in which mortars are an important material. An idea of how extensive the work of Committee C-12 will eventually be is given by a review of the subcommittee organization.

One of the most important activities of the committee will be the correlation of research investi-

gations that have been carried out on masonry mortars, and a determination of the present gaps in existing knowledge. A subcommittee on correlation of research is accordingly contemplated in the committee's organization. Since many features of specification requirements and test procedures are involved, a rather extensive subcommittee organization has been determined upon by the temporary advisory committee.

1. *Advisory.*—To outline the activities of the committee and to conduct the business of the committee between meetings.
2. *Publications.*—To act as an editorial committee in the preparation of reports and to establish general publication policies.
3. *Correlation and Research.*—To bring together such information as is in existence regarding masonry mortars and to correlate these data; to lay out research programs and to correlate research activities.
4. *Specifications.*—To prepare specifications for masonry mortars of various classes.
5. *Definitions.*—Define terms employed in masonry construction and to standardize the use of such terms.
6. *Testing Apparatus and Testing Methods.*—To devise apparatus and testing methods for standard mortar tests as required by Subcommittee on Specifications.
7. *Cementing and Plasticizing Materials.*—To gather information concerning various cement-

ing and plasticizing materials, their properties and uses.

8. *Mortar Sands*.—To gather information concerning the mortar sands in common use in various parts of the United States, the effect of character of sand upon the various properties of mortars including strength, plasticity and shrinkage.
9. *Preparation of Mortars*.—To make a study of the practice in the use of mortar materials and in the proportioning and mixing of mortars; to make a study of the possibility of improving practice in the use of mortar materials.
10. *Unit Masonry Construction Practice*.—To make a study of the practice regarding unit masonry construction of all classes; to correlate these practices and to carry out such investigations as are necessary for improved practice.
11. *Plasticity Tests*.—To organize and carry out such programs of investigation as are necessary to establish adequate methods of determining plasticity, consistency, rate of hardening; to study effect of various cementing and plasticizing materials upon plasticity, and to set up plasticity standards.
12. *Strength Tests*.—To review the results of such strength tests as have been made both upon mortars themselves and upon masonry specimens. To formulate an adequate program of tests to determine the factors which influence the strength of masonry in compression, flexure and shear.
13. *Volume Change Tests*.—To organize and carry out such tests as may be necessary to determine volume changes and the factors which influence them.
14. *Durability Tests*.—To make a study of test methods for determining the durability of masonry and to organize and carry out a program of tests which will establish the factors which influence durability.
15. *Permeability Tests*.—To organize a program of building and laboratory research which will seek to determine the factors which affect permeability and to establish methods of masonry manufacture which will insure impermeable walls.
16. *Efflorescence and Staining*.—To make such field and laboratory investigations as may be necessary to establish the causes of efflorescence and staining, and remedies therefor.

The personnel of the committee are: Chairman, R. E. Davis; Vice-Chairmen, J. C. Pearson and T. R. Lawson; Secretary, C. L. Warwick; Temporary Advisory Committee, Stanton Walker, J. W. McBurney, D. E. Parsons, and M. O. Withey.

Producers of Materials for Mortars

Cementing Materials:

Allentown Portland Cement Co., W. H. Andrews, Supervising Chemist, Conshocken, Pa.
 L. E. Johnson, Secretary and General Manager, Finishing Lime Assn. of Ohio, Toledo, Ohio.
 Louisville Cement Co., H. D. Baylor, Vice-President, Speed, Ind.

Medusa Portland Cement Co., W. L. White, Jr., Assistant General Manager, Cleveland, Ohio. (Alan Jackson, alternate.)

National Lime Assn., N. G. Hough, President, Washington, D. C. (L. S. Trainor, alternate.)

J. C. Pearson, Director of Research, Lehigh Portland Cement Co., Allentown, Pa.

Portland Cement Assn., H. F. Gonnerman, Manager, Research Laboratory, Chicago, Ill. (C. G. Walker, alternate.)

Riverton Lime Co., W. E. Carson, President, Riverton, Va.

Utica Hydraulic Cement Co., S. G. Seaton, Chief Chemist, Utica, Ill.

Warner Co., J. A. Murray, Chief Chemist, Devault, Pa.

Aggregates:

National Crushed Stone Assn., A. T. Goldbeck, Director, Bureau of Engineering, Washington, D. C.

National Sand and Gravel Assn., Stanton Walker, Director, Engineering and Research Division, Washington, D. C.; also C. E. Proudley, Assistant Director.

National Slag Assn., R. E. Roscoe, Chemical Engineer, Bessemer Cement Co., Youngstown, Ohio.

Producers of Masonry Units

American Face Brick Assn., G. S. Eaton, Secretary-Treasurer, Chicago, Ill.

H. S. Brightly, Secretary-Director, Building Stone Assn. of Indiana, Bloomington, Ind.

Cast Stone Inst., Chicago, Ill. (representative to be appointed).

Clay Products Inst. of California, N. W. Kelch, Secretary-Manager, Los Angeles, Calif.

Common Brick Mfrs. Assn. of America, J. W. McBurney, Research Associate Bureau of Standards, Washington, D. C.

Gypsum Assn., H. J. Schweim, Secretary and Chief Engineer, Chicago, Ill.

National Terra Cotta Society, W. F. Lockhardt, Secretary-Director, New York City.

Structural Clay Tile Assn., E. C. Kerth, Engineer, Secretary, Chicago, Ill.

U. S. Gypsum Co., C. K. Roos, Research Manager, Chicago, Ill.

Consumers and General Interests

American Inst. of Architects, Prof. C. M. Gay, School of Fine Arts, University of Pennsylvania, Philadelphia, Pa. (F. Leo Smith, alternate.)

F. O. Anderegg, Consulting Specialist on Building Materials, Pittsburgh, Pa.

R. E. Davis, Professor of Civil Engineering, University of California, Berkeley, Calif.

J. W. Ginder, Superintendent, Architectural Engineering Division, U. S. Treasury Dept., Washington, D. C.

T. R. Lawson, Professor of Civil Engineering, Rensselaer Polytechnic Inst., Troy, N. Y.

L. A. Palmer, Masonry Mortar Research Fellowship, Bureau of Standards, Washington, D. C.

D. E. Parsons, Chief, Masonry Construction Section, Bureau of Standards, Washington, D. C.

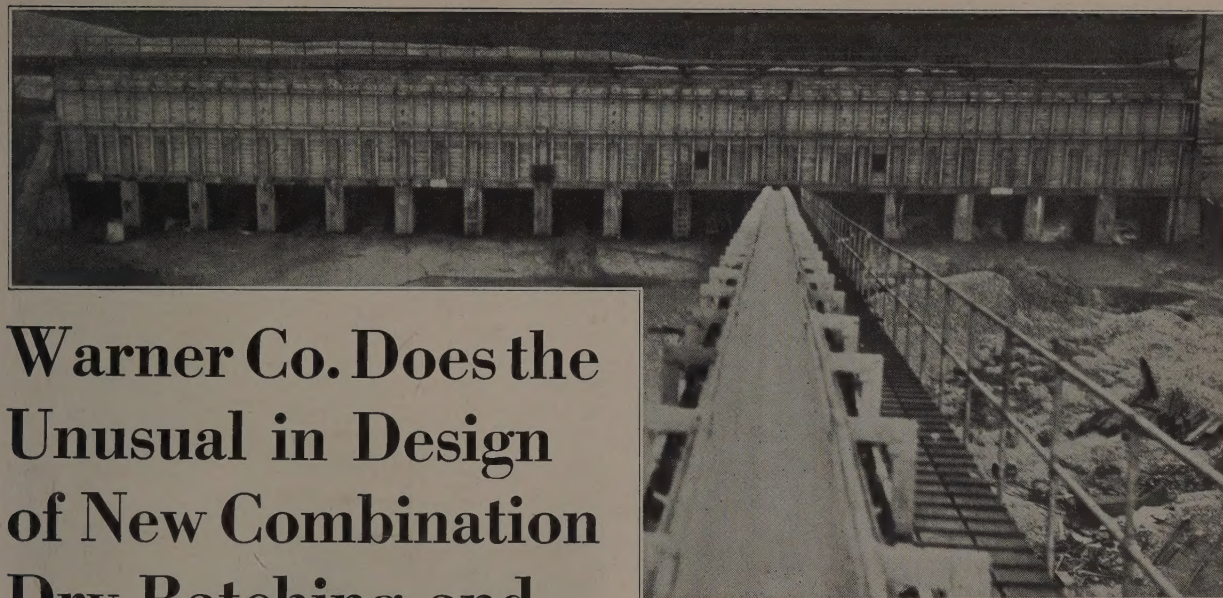
M. O. Withey, Professor of Mechanics, University of Wisconsin, Madison, Wis.

J. R. Withrow, Professor of Chemical Engineering, Ohio State University, Columbus, Ohio.

W. D. Guion, Commissioner of Buildings, Cleveland, Ohio. (Informally representing Building Officials Conference.)

A number of the standing committees of the Society are interested in the work of the new committee and are represented thereon by members, who will serve in a liaison capacity.

With the organization of Committee C-12 on Mortars for Unit Masonry, there are 51 standing committees of the A.S.T.M. with a total membership of about 2,500. These committees study the properties of materials, develop standards, methods of test, definitions and recommended practices.



Looking down main conveyor to truck-loading bins. Note skirt boards for protection from strong winds.

Warner Co. Does the Unusual in Design of New Combination Dry-Batching and Central-Mix Plant

AT the recent Second Annual Convention of the National Ready Mixed Concrete Assn., held in Pittsburgh on January 25 and 26, the point was brought out that a pre-mixed-concrete plant should be considered as a modern factory turning out a consistent, high-grade but perishable product under accurate control and rigid supervision. This description can be suitably applied to the new central-mixing and dry-batching plant of the Warner Co. at Morrisville, Pa. In its design, appearance and efficiency of operation and control this plant is a modern concrete factory of the most advanced type. It has a capacity of 100 cu.yd. of concrete and 200 tons of dry-batched aggregates per hour at the same time.

In appearance the plant is actually a beautiful piece of structural engineering enhanced by the aluminum paint which coats all the machinery and the plant exterior and interior. In design it leaves nothing to be desired. It is compact and simple and yet has ample space for all the equipment used and is as nearly automatic as a plant can be which uses the most approved modern methods.

Unquestionably the outstanding feature of this plant is its unusual steel bin construction and the manner in which the materials are fed to the measuring equipment. The bin structure consists of a circular water-tank which is 10 ft. in diameter and has a convex bottom that eliminates the necessity of bracing. Radiating from this central tank are 8 partitions connecting it with a circular tank which is 30 ft. in diameter and forms the outside of the bin structure. Of the 9 outside compartments formed in this manner, 7 are used to store aggregates and have a capacity of 100 tons each. The other two compartments are used for cement

Compact Arrangement of Bins and Water-Supply Tank Big Feature of This Modern Operation

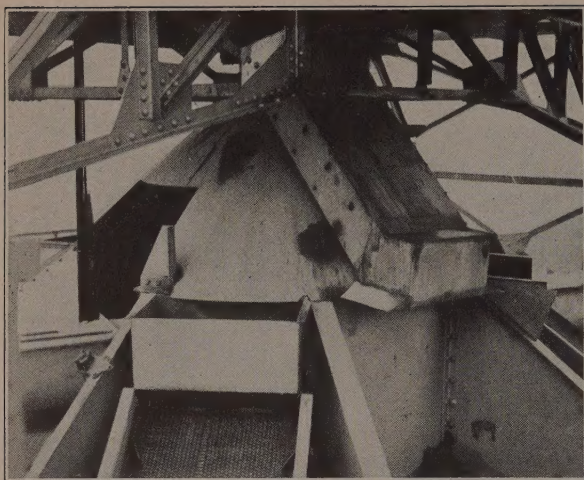
storage and have a capacity of 600 bbl. each. Each of these compartments is covered but has an opening and a ladder inside to facilitate inspection and cleaning. In order to centralize the discharge points of these compartments at the weighing batchers they are extended below the bottom of the water-tank, which is thus completely surrounded by bulk materials except on its top.

The combination of a dry-batching unit with a central-mixing plant is a fairly common practice, but the manner in which this is done is a departure. The arrangement is such that neither operation interferes in any way with the other, and each can be performed at full capacity either separately or simultaneously. This was achieved with the minimum expense and extra equipment.

Another feature is the provision made for washing and draining all coarse aggregates to insure absolute cleanliness. The drainage system used also keeps the aggregates at as uniform a moisture content as it is possible to achieve without resorting to such a tedious and expensive method as inundation.

On June 3, 1931, this new plant began its deliveries in the Trenton district by furnishing concrete for the new U. S. Post Office being built in Trenton. The plant, it is said, was the first in the east to be officially approved by the U. S. Treasury Department for the delivery of pre-mixed concrete for government structures. Concrete is now being de-

By W. E. TRAUFFER



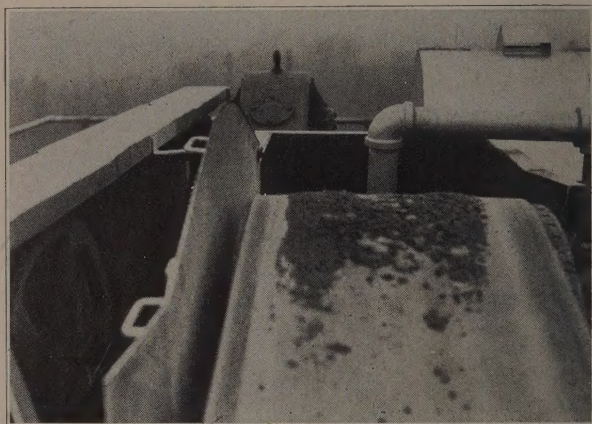
Stationary aggregate-rinsing screens with selective chute above.

livered by this plant for highways, streets, sidewalks, public and private buildings, and all the other work for which concrete is being used in the states of Pennsylvania and New Jersey, which are well known to be among the strictest states in this country in their specifications and on the enforcement of them. The plant is located on U. S. Highway No. 13, $\frac{1}{2}$ mi. southeast of Morrisville, Pa., and 2 mi. from Trenton, N. J., adjacent to the old Morrisville gravel plant and $1\frac{1}{4}$ mi. north of the Van Sciver plant of the Warner Co.

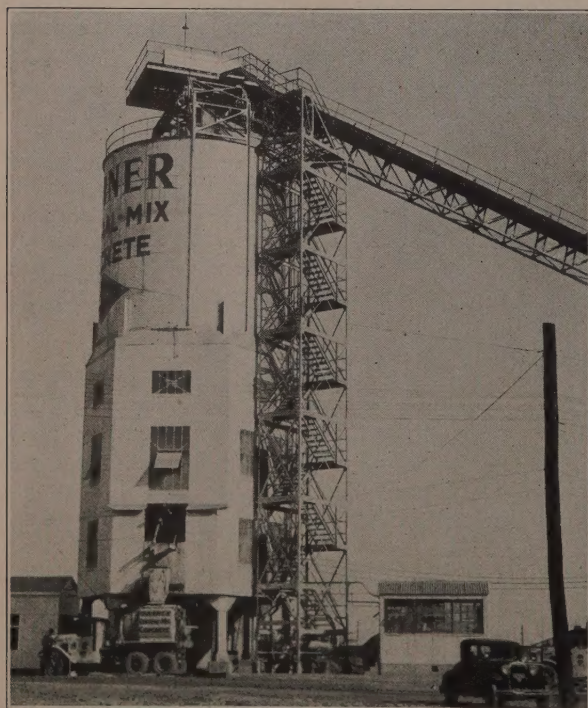
Bulk cement is received in box-cars on a siding alongside the plant. A Latimer power-scraper discharges to the boot of a steel-inclosed chain-bucket elevator. This discharges to a 16-in. Latimer dis-

tributing screw-conveyor on the top of the plant. A flap gate controls the discharge of the screw to either of the two 600-bbl. cement-storage compartments. An automatic signal system turns on lights in the cement-unloading room when the cement bins are full. The cement elevator is driven by a 40-hp. Westinghouse motor through a Link-Belt speed-reducer and a single roller chain. A chain and bevel-gear drive from the low-speed shaft of the reducer also drives the screw-conveyor.

Aggregates are received at the plant in 44-ton hopper-bottom cars drawn by steam locomotives. A new storage track with a capacity of 20 loaded cars was put in last summer and the cars are "spotted" by gravity at the track-hopper. The steel track-hopper has a slide gate, controlled from above, which feeds to the belt-conveyor leading to the mixing plant. This conveyor passes underneath one



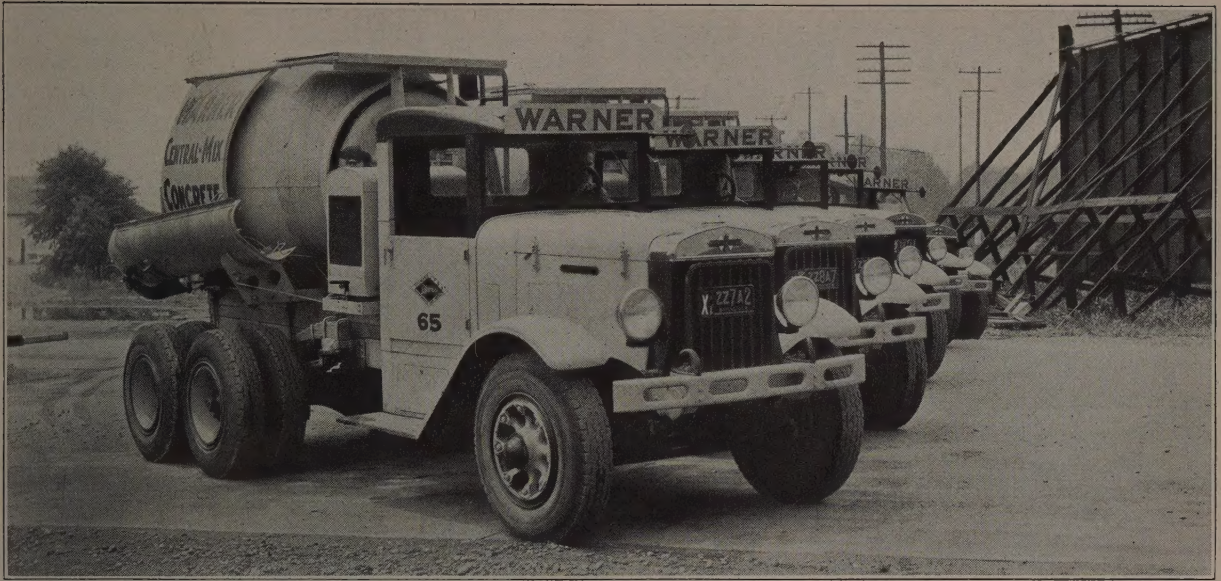
Chain and speed-reducer drive on the main belt conveyor.



New central-mixing plant of Warner Co. at Morrisville, Pa.

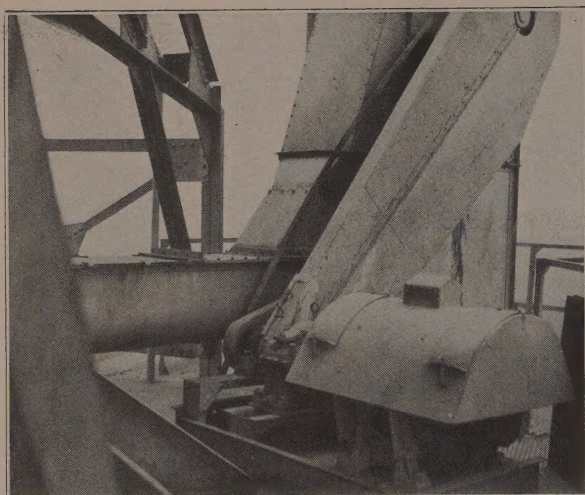
compartment of the old 16-compartment truck-loading bins for the Morrisville gravel plant. These bins have a total capacity of about 2,400 tons and are filled from cars on a trestle above them. The bin above the conveyor is used as additional storage capacity for $\frac{3}{4}$ -in. gravel and can feed through a gate to the plant conveyor when desired. The other 15 compartments are used as emergency storage of other sizes, so trucks can be loaded under them and weighed on a truck scale as was done before this new plant was built. These bins are built of timber set on concrete foundations.

The inclined belt-conveyor feeding materials to the plant is 30 in. wide and operates on 390-ft. centers. It has a capacity of 400 tons per hr. at a speed of 300 ft. per min. The framework is of structural steel and is supported on three structural bents in addition to the head and tail supports. The conveyor has a gravity take-up and is driven by a 100-hp. Westinghouse motor through a Link-Belt herringbone gear speed-reducer and double roller chain with double sprockets. An automatic band-brake prevents reversing of this belt under load in case of power failure. Because of the length of this conveyor it was found necessary to install wind-boards to keep the conveyor belt from being blown about and getting damaged when not loaded. These boards are rounded at all points where they come



Above—A fleet of Warner Co. six-wheel delivery trucks. Left—Sending an order to the mixer floor by pneumatic tube. Right—Trucks on the job discharging to foundation forms. Bottom, left—Water discharging through launder plate over the bins. Bottom, right—Carloads of aggregates being "spotted" for discharge to track hopper.





Drive of cement elevator and distributing screw-conveyor. Note the novel type of cover to protect motor.

in contact with the belt. A water-line sprays the gravel as it leaves the end of the belt-conveyor but is not used when sand is being handled.

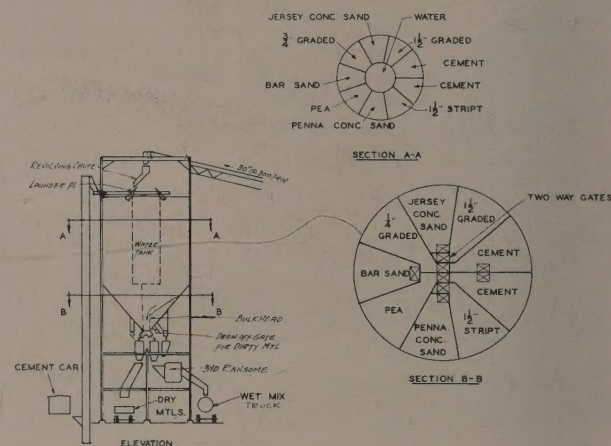
The conveyor discharges through a revolving chute into any of the seven 100-ton aggregate-storage compartments on the top of the plant. Sand is discharged directly into three of the bins. Each of the four gravel compartments, however, has a 3-ft. by 4-ft. stationary screen over which the gravel must pass before going to storage to insure the removal of all fine particles and silt. No water is added at the screens. Each of these screens can be adjusted for pitch according to the type of material being handled. The sizes of sand stored are: commercial, New Jersey, and bar (plaster). The four sizes of gravel stored are: New Jersey $\frac{3}{4}$ -in.; pea; graded $1\frac{1}{2}$ -in.; and $1\frac{1}{2}$ -in. stripped.

An interesting feature is the manner in which the feed of aggregates to the bins is controlled from the lower end of the conveyor. A flap in each bin drops, when the material falls below a certain level, and turns on a red signal light. This informs the



Hand-winch controlling discharge chute at top of the plant.

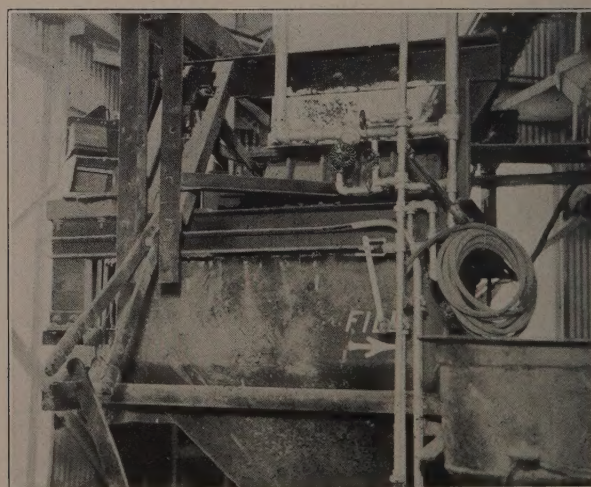
man at the unloading hopper that this bin will hold another car-load of material, which he then sends up to it. A cable control system, operated by a hand-winch at the foot of the conveyor, turns the



Elevation and sections of the wet-mix and dry-material plant.

discharge chute by means of another pulley at the top of the plant. The cable is supported on pulleys located inside the conveyor framework, and markings on the cable and a stationary board allow the operator instantly to select the bin into which the chute is to discharge.

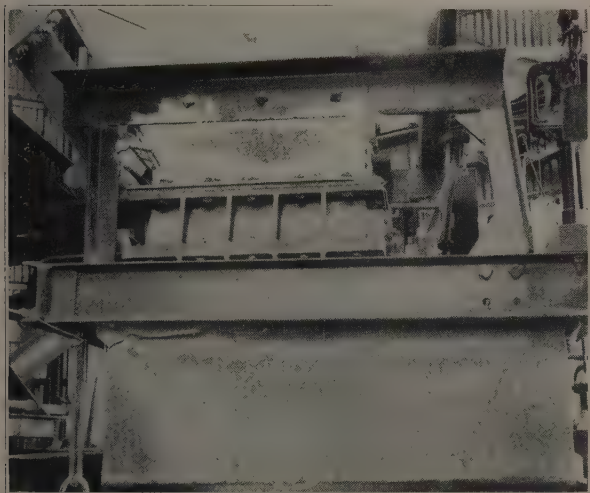
Arching of cement in the two cement bins is prevented by perforated pipes running up the inside of the bins for air agitation. No air jets other than these are used. The cement is fed to two Fuller Co. 14-in. by 24-in. lever-controlled rotary gates, one for each bin. These discharge into a 2,400-lb. specially-designed weighing batcher which has a Howe



A view of the batching equipment.

beam-scale and a Weightograph. This discharges into the concrete-mixer by means of a lever-controlled sliding gate, which is of the company's own design and allows any overweight to be held back. A Schaffer electric vibrator prevents any of the cement from sticking in the hopper.

The six sizes of concrete aggregates, not including the bar sand, are discharged through six lever-controlled segmental gates to a 7-ton weighing batcher with a Howe scale and Weightograph. These gates have perforated plates which are similar to those above and discharge the water and "fines" to a drain-pipe. This batcher discharges through a counterbalanced gate. Water is meas-



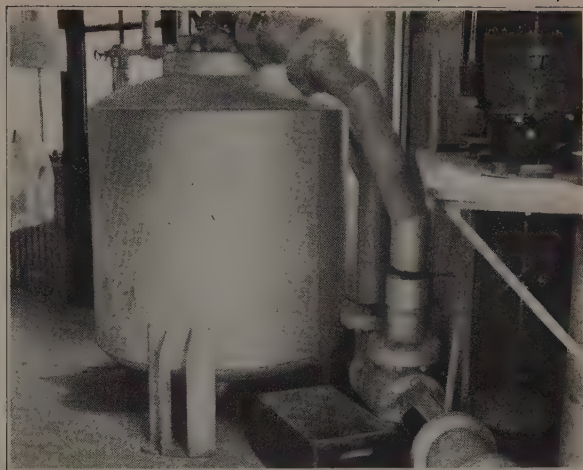
Rotary valve feeding from bin to cement-weighing batcher. Scale at right.

ured in a Ransome 160-gal. water-tank which is controlled by an air-valve actuated by the operator from his post. A Franklin Air Compressor Works 1-cyl. vertical air-compressor, belt-driven by a 5-hp. General Electric motor, furnishes air for this and the cement agitation.

The six bins containing concrete aggregates have split feeds so that they can feed through six additional gates similar to those on the concrete side. These feed to a 9-ton weighing batcher which has a Howe beam-scale and a Weightograph for dry-batching. Bar sand is fed to this batcher through a separate gate. A bulkhead in each aggregate bin



Aggregate-weighing batcher and levers for controlling bin gates. Scale and quick-reading device at right with tables of mix proportions below.

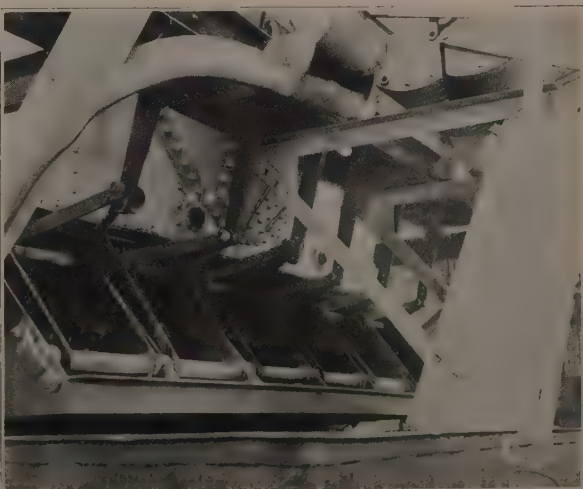


Water-measuring tank with air-operated valve. Pneumatic-tube station which communicates with office at right.

allows excess water to drain off through special dewatering chutes and gates to a waste-pipe. These chutes are cleaned out every day to prevent the formation of silt which might impede the filtration. The dry-batcher also has a counterbalanced gate and discharges through a welded-steel chute into regular delivery trucks.

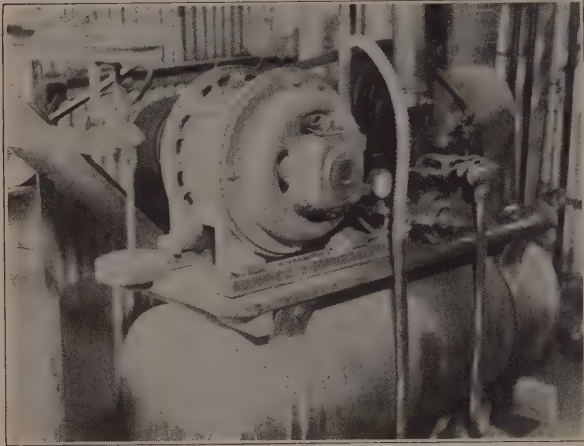
The cement, aggregates, and water are discharged into a Ransome 3-cu.yd. concrete-mixer on the floor below. This is driven through a Link-Belt speed-reducer and Gates Vulco Rope V-belt drive by a 50-hp. Westinghouse motor. The V-belt drive has a 1-to-1 ratio, and this arrangement of reducer and belt has the advantage that there is no large pulley to act as a flywheel. The belt drive also takes up any shocks in operation.

Concrete deliveries are at present being made by five International 18-ton trucks with four dual-pneumatic-tired rear wheels. These trucks have Chain-Belt Rex 3-4½-cu.yd. Moto-Mixer bodies which are operated by LeRoi auxiliary gasoline engines. When additional trucks are needed they are driven up from Philadelphia.



Gates feeding dry batcher with clam-shell gate for bar sand and bin-drainage pipe above.

Two offices are maintained at this plant. One is the main office for the Morrisville district and all orders for concrete are received here. They are then transmitted to the concrete-plant office which is connected with the batching floor by a Lamson pneumatic tube and a private telephone. This office harmonizes in appearance with the plant as it also has concrete foundations and metal inclosure. The main office has a Howe beam truck-scale and

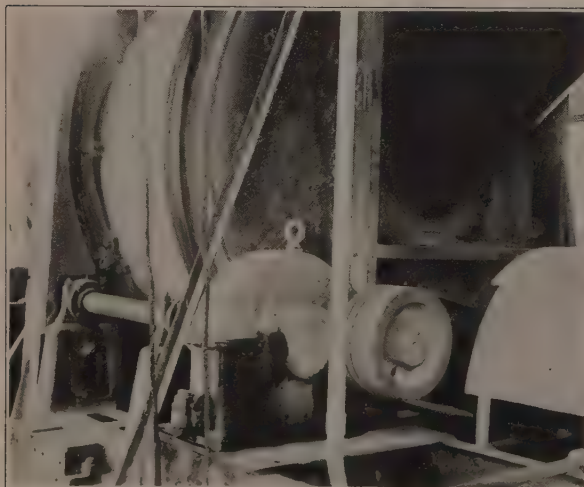


Small air-compressor and storage unit for agitating cement.

Weightograph for weighing shipments of gravel and sand from the track storage-bins.

Water for plant operation is furnished direct from a well at the old Morrisville gravel plant by a Gould piston pump. The water-supply tank, with a capacity of 16,800 gal., forms the core of the circular bin-storage of the concrete plant. A Fuller Co. electric gauge automatically turns on the pump when the level of the water in the tank drops 2 ft. A Worthington 4-in. centrifugal pump, driven by a 7½-hp. Westinghouse motor, furnishes water from this tank for the gravel-washing spray at the head of the conveyor.

Ample facilities are provided for heating the materials for cold-weather operation. A small building



V-belt and speed-reducer drive of the concrete mixer.



Truck being loaded at the mixer.

alongside the plant houses an 80-hp. Erie City boiler, which furnishes steam at 90 lb. pressure for heating the aggregates, the mixing water, and the plant and yard offices. The water in the large central tank is heated by a 6-in. steam-pipe which is in the center of the tank and has ¼-in. holes at regular intervals to release the steam. An automatic temperature control on the boiler allows the water to be kept at any desired temperature. In cold weather steam is kept in the water 24 hr. a day in order to prevent the freezing of the aggregates over night. Twelve plugs, one above each of the twelve gates on both sides of the aggregate bins, allow live steam to be injected. Heating coils are installed in the office and laboratory. A small coal-stove keeps the batching floor at a comfortable temperature.

The plant and all its details were designed by the company engineers under the direction of Irving Warner, chief engineer, and E. L. Shoemaker, assistant chief engineer, who also supervised its construction. All equipment was furnished according to specifications. The Baldwin Locomotive works fabricated the steel storage-tank and the Blaw-Knox Co. furnished the electro-forged steel stairs and walkways. The plant and office are inclosed by Robertson protected metal. Hamilton Rubber Co. conveyor belting, Jenkins water-valves, and Reading steel drain-pipe are used. The main belt-conveyor has Link-Belt anti-friction idlers and Dodge anti-friction head- and tail-pulleys.

No details were overlooked in the design of this plant. Although it is almost entirely of fireproof construction, fire extinguishers are provided. A box on the batcher floor contains two Foamite-Childs extinguishers and a red light on the box makes it easy to find. For the safety of the employees and for protection against dust and weather all drives and exposed motors are inclosed. Each of the elevator and belt-conveyor motors has an original type of housing which is used in all the Warner plants. This housing is designed not only to protect the motor against the elements but to provide efficient ventilation for the motor through its own action regardless of atmospheric conditions.

(Continued on page 50)

Ohio's Progress Due Largely to State's Abundant Mineral Resources



Limestone quarry of Ohio Hydrate & Supply Co., Woodville, O.

Convenient Locations of Deposits Chief Factor in Their Widespread Development

By WILBUR STOUT
State Geologist, Ohio Geological Survey

THE mineral resources of Ohio consist not of the unusual or spectacular materials but of the common ordinary kinds that are fitted so well to meet the general needs of man. The high development of the state is due in large measure to the abundance and quality of the mineral resources and to their intelligent employment for many purposes. The pioneer settlers, mainly through necessity, first turned the local rocks to profitable account in building homes, mills, factories, dams, bridges, and canal locks; in the refining of the ores; in the production of crude pottery for household needs; in making buhr-stones for grinding grain; and in various other ways. The succeeding generations have augmented these early efforts by increasing both the quality and the scope of the work.

The resources consist mainly of sedimentary rocks such as coal, clay, shale, limestone, sandstone, conglomerate, iron ore, marl, and peat. To these may be added petroleum, natural gas, and brines which are associated with the stratified but deep-seated rocks. Such materials are conveniently distributed over the state, are present usually in large quantities, occur under favorable conditions for recovery, and have the necessary qualities for satisfactory utilization. Ohio holds sixth rank in the states in the value of its mineral resources. It is surpassed by Pennsylvania largely through coal and cement; by Oklahoma, California, and Texas

through petroleum and natural gas; and by West Virginia through coal and natural gas.

According to the latest estimates of the Federal Government, the mineral resources of Ohio are as follows:

	Quantity	Value
Portland cement (bbl.)	14,928,183	\$ 10,938,646
Clay Products	.....	81,848,422
Clay, raw (short tons)	414,486	979,461
Coal (short tons)	15,641,225	26,439,000
Grindstones and pulpstones (short tons)	23,877	790,203
Gypsum (short tons)	356,734	3,301,440
Lime (short tons)	962,415	7,935,656
Natural gas (1,000 cu. ft.)	57,936,000	32,090,000
Natural gasoline (gal.)	13,174,000	1,146,000
Petroleum (bbl.)	7,015,000	14,470,000
Rubbing stones, scythe-stones, and whetstones (short tons)	296	45,299
Salt (short tons)	1,449,360	3,199,903
Sand and gravel (short tons)	14,286,169	9,116,356
Stone (short tons)	14,771,030	14,957,234
Miscellaneous	.....	4,884,661
Total	.....	\$212,142,281

The consolidated rocks appearing at the surface in Ohio are all of sedimentary origin, that is, they were laid down in or by the agency of water. The strata of the older systems, Ordovician, Silurian, Devonian, and Mississippian, outcropping in the western half of the state, are of marine derivation as is shown by the fossil evidence. These systems furnish most of the limestone used in the state for a wide variety of purposes. Further, they yield

gypsum, salt, brine, building stone, petroleum, and natural gas. The Pennsylvanian period opened with unstable conditions, shifting from marine through brackish water to fresh water. During the closing stages of this time, however, the rocks were formed only in the fresh water basins then existing on the land surface. The Pennsylvanian deposits are especially important for the great wealth of coal and clay. Rocks of lesser value are

A GENERAL SECTION OF THE ROCKS OF OHIO

System	Series or Formation	Member or Bed	Kind of Material	Thickness (ft.) (ft.)		Remarks
Mississippian	Mauch Chunk		Shales and shaly sandstones	0	0	Not known in Ohio.
	Maxville		Limestones with calcareous shale partings	10	10	Very unsteady, generally absent, thickness 1 to 140 ft.
	Logan	Vinton	Limestones and shales	80		The Logan series of rocks is quite variable in character and in thickness. In northern Ohio other facies appear as Shenango, Meadville, and Sharpville. Keener oil sand same as Vinton.
		Allensville	Conglomerates, sandstones, and shales	16	170	
		Byer	Sandstones and sandy shales	70		
		Berne	Conglomerate, coarse, fossiliferous	4		
	Cuyahoga	Black Hand	Conglomerate, sandstone, shale	120	335	Other facies Fairfield, Lithopolis, Granville, Toboso, Churn Creek, Vanceburg, Rarden, Buena Vista, Henley, Portsmouth, Armstrong, Burbank, Breaksville, Chardon and Aurora.
		Raccoon	Shales and sandstones	215		
	Sunbury		Shale, fissile, carbonaceous	20	20	Persistent, thickness 10 to 30 feet.
			Sandstone with shale partings	30		Varies from 10 to 200 feet in thickness. To the oil driller the upper part is known as Berea, Berea Grit or First Sand, and lower part as Second or Butler Gas sand.
	Berea		Shale, siliceous, local	3	45	
			Sandstone with shale partings	12		
Devonian	Bedford		Shale, soft, pinkish, ferruginous	65	85	Persistent across state, but variable in character. In the Cleveland district, the Euclid lentil of sandstone appears in lower portion.
			Shale, gray, with sandstones, Euclid lentil	20		
	Ohio	Cleveland	Shale, fissile, dark, carbonaceous	100	600	Thickness varies from 400 to 2,800 feet. Expansion about 25 feet per mile east. Chagrin local, other persistent, but variable in character.
		Chagrin	Shale, gray, siliceous	70		
		Huron	Shale, fissile, dark, carbonaceous	430		
	Prout (Widder)		Limestone, impure, local	5	5	Local deposits in northern Ohio, better developed in Michigan.
	Olentangy		Shale, gray, siliceous, calcareous	30	30	Unsteady, best developed in central and northern Ohio.
	Delaware		Limestones and calcareous shales, dark gray	45	45	Traverse equivalent to Olentangy and Delaware. Persistent, but variable in character.
	Marcellus		Shale, fissile, black, carbonaceous	2	2	Very local on outcrop, better developed under covering.
	Columbus	Delhi-Klondyke	Limestone, gray	35	80	Persistent, but variable vertically and laterally. Lower Helderburg or Corniferous of early surveys equal Columbus and Delaware.
		Belle-point	Limestone, dolomitic, drab	45		
	Oriskany		Sandstone, local, irregular	10	10	Thickness from 1 to 100 feet, Oriskany and Austintown sand of the driller. Thickens eastward.
	Detroit River (Upper Monroe)	Lucas	Dolomite, gray, thin bedded	100	175	The Anderson and Flat Rock formations are well developed in Michigan, but do not appear in Ohio. Lucas best developed in Lucas and Wood counties and Amherstburg in Ottawa and Sandusky.
		Amherstburg	Dolomite, porous, drab	75		
		Anderson	Limestone, compact, light brown	0		
		Flat Rock	Dolomite, compact, dark gray	0		
	Sylvania		Sandstone, local	10	10	Very unsteady, best deposits in Lucas County.
Silurian	Bass Island (Lower Monroe)	Raisin River	Dolomite, thin bedded, drab	50	750	Raisin River and Put-in-Bay dolomites are confined to small areas in the lake district, the Tymochtee shale is widely distributed, the Greenfield dolomite is best developed in south central Ohio and the Salina salt series is prominent only under deep covering in northeastern Ohio.
		Put-in-Bay	Dolomite, massive, drab	50		
		Tymochtee	Shales, calcareous, gray	150		
		Greenfield	Dolomite, thin bedded, drab	100		
		Salina	Rocksalt, limestone, and shale	400		
	Newburg		Sandstone, unsteady	10	10	Newburg, statler sand of driller, best developed northeast Ohio.
	Niagara	Cedarville-Guelph	Dolomite, massive, drab	60	325	Niagara group best exposed in southwestern Ohio, but certain members are recognized by the driller on eastward to the Pennsylvania line and then go on to the excellent exposures in the gorge at the Niagara Falls. The important members are the Cedarville and Brassfield.
		Springfield	Dolomite, massive, light	15		
		West Union	Dolomite, thin bedded, local	50		
		Euphemia	Limestone, thin to massive, light	20		

(Table continues on opposite page)

shale, sandstone, limestone, conglomerate, and iron ore. Beds laid down during Permian time are entirely of fresh water origin and, economically, are of little value.

The unconsolidated rocks found as a surface coating over much of the state belong to the Quaternary system which is subdivided into two series, Pleistocene and Recent. The Pleistocene strata of most importance are those derived directly or indirectly through the great glaciers that extended over about two-thirds of Ohio. The deposits immediately attributed to these moving masses of ice

are till, sand and gravel, imperfectly sorted in kames and eskers, and boulders, irregular in distribution and in size. The materials most useful are the well sorted sands and gravels that were differentially separated by moving water and were then deposited as valley trains along the courses of the streams flowing outward from the ice sheets. These furnish most of the sand and gravel marketed in Ohio. The Recent deposits are alluviums and sands and gravels along the present streams. Such beds are only locally of value.

Point Pleasant Member.—In Ohio the oldest

A GENERAL SECTION OF THE ROCKS OF OHIO—(Continued)

System	Series or Formation	Member or Bed	Kind of Material	Thickness (ft.)	Remarks
Silurian (Continued)	Niagara	Alger (Rochester)	Shale, calcareous, variegated	125	Niagara group best exposed in southwestern Ohio, but certain members are recognized by the driller on eastward to the Pennsylvania line and then go on to the excellent exposures in the gorge at the Niagara Falls. The important members are the Cedarville and Brassfield.
		Dayton (Irondequoit)	Limestone, light, irregular	10	
			Shale, calcareous with some limestone	5	
		Brassfield (Wolcott)	Limestone, light irregular	30	
		Sodus	Shale, soft, irregular, gray to pink	10	
	Medina	Clinton (Medina)	Sandstone, light to pink, fine grained	15	Great oil and gas sand of eastern Ohio. Belfast correlative with Elkhorn shale.
		Belfast (Queenstown)	Shale, argillaceous, variable	40	
	Cincinnati Group	Whitewater	Oxford Shales and limestones	20	Richmond series consists of a vast series of thin limestones and shales, divided into members mainly on fossil and not lithologic evidence. Highly fossiliferous.
		Saluda	Shales and limestones	30	
		Wei burg	Shales and limestones	25	
		Liberty	Shales with thin blue limestones	25	25
		Blanchester	Shales with thin limestones	35	
		Clarksville	Shales with thin limestones	20	
		Fort Ancient	Shales with thin limestone	40	
		Arnhem	Oregonia Shales with thin limestones	35	80
		Sunset	Shales, nodular limestones	45	
		Mount Auburn	Shales with thin limestones	30	Maysville series much the same as the overlying Richmond.
Ordovician	Maysville	McMillan	Corryville Shales with some limestones	40	85
		Bellevue	Limestones with some shales	15	
		Fairview	Fairmont Shales with thin limestones	70	115
		Mount Hope	Shales with some limestones	45	
	Eden	McMicken	Shales with few limestones	50	220
		Southgate	Shales with some limestones	160	
		Economy	Shales with thin limestones	10	
	Utica		Shales, calcareous, gray to brown	15	15
	Cynthiana	Point Pleasant	Limestones with some shales	70	100
		Greendale	Limestones with thin shale partings	30	
	Lexington (Trenton or Galena)	Perrysville	Limestones with thin shales	25	260
		Bigby	Limestone mainly	115	
		Wilmore (Jassamine)	Limestone mainly	80	
		Hermitage	Limestones mainly	30	
		Curdsville	Limestones mainly	10	
	High Bridge (Lowville, Stones River, Black River, Chazy)	Tyrone	Limestones mainly	90	390
		Oregon	Limestones mainly	20	
		Camp Nelson	Limestones mainly	280	
	St. Peter		Sandstone, variable, local	50	50
	Lower Magnesian (Calceiferous, Beckmantown)		Dolomites		475
Cambrjan			Dolomites		Reached by drill in western Ohio. Little known of distribution and thickness.
Algonkian			Modified sedimentary, metamorphic, and igneous rocks		Reached by drill in western Ohio.
Archean			Igneous rocks		

rocks appearing at the surface are the Point Pleasant beds of the Cynthiana series of the Ordovician system. The typical exposures are along the banks of the Ohio River in the vicinity of Point Pleasant in Clermont County, which lies about 20 mi. above Cincinnati. The deposit consists of thin bedded limestones separated by partings of calcareous shale. The usual range in thickness of the limestone layers is from 1 in. to 1 ft. The stone is fine-grained, compact, brownish-gray, and weather resistant. It is a siliceous, ferruginous, low magnesium limestone, rather uniform in composition. The thicker layers have been used to some extent for many years for rough building stone in walls, foundations, piers, and abutments.

Cincinnati Group.—The upper portion of the Ordovician system is well represented in southwestern Ohio by the Cincinnati group of rocks which has a mean thickness of about 765 ft. and an area of close to 3,260 sq. mi. It is divided into the Utica, Eden, Maysville, Richmond, and Medina series which are further subdivided into sub-series and formations. As a whole the group is characterized by the uniformity and type of deposition and by the abundance and preservation of fossils. The separate series will be considered in a brief way.

Utica Series.—In Ohio the Utica deposits consist mainly of calcareous shales varying in color from gray to shades of brown and green. Usually the thickness of the strata is not more than 15 ft. It has little economic value.

Eden Series.—The Eden or Latonia series is regularly made up of three formations which in ascending order are Economy, Southgate, and McMickin. The thickness is from 200 to 230 ft. The deposit consists mainly of bluish gray calcareous shale in which thin layers of limestone are rather widely spaced. The stone is decidedly coarse grained and crystalline and is resistant to weathering. The thickness of the interspersed layers ranges from 1 in. to 10 in. Both shale and limestone are very fossiliferous. The Eden series is present over wide areas in Hamilton, Butler, Warren, Clermont, and Brown counties. The stone supplies local needs for rough masonry.

Maysville Series.—The Maysville series, made up of some 200 ft. of strata, consist mainly of calcareous shale in which thin to medium bedded limestones are rather regularly but widely spaced. It is divided into the Fairview group with the Mount Hope and Fairmont members and the McMillan group with the Bellevue, Corryville, and Mount Auburn members. The shales are calcareous in composition, blue or blue-gray in color, and fine in texture. The limestone layers constitute from 25 to 50 per cent. of the whole. They vary from 1 in. to 10 in. in thickness, but ordinarily they measure from 3 in. to 8 in. The stone is blue, crystalline, hard, and weather resistant. Many of these layers are suitable for building purposes and have been quarried around Cincinnati and vicinity for many years. This stone and the associated shale are quite fossiliferous. The following analysis is approximately representative:

	Per Cent.
Silica (SiO_2)	33.08
Alumina (Al_2O_3)	10.78
Ferric oxide (Fe_2O_3)	2.80
Calcium carbonate (CaCO_3)	46.60
Magnesium carbonate (MgCO_3)	4.19

The composition of this limestone shows that it is siliceous, argillaceous, and dolomitic in character. It is not desirable for Portland cement or caustic lime. Its chief value as a building stone is for rough masonry such as foundations and walls.

Richmond Series.—The general features of the Richmond series of strata closely resemble the Maysville in the arrangement of the beds, in the lithology of the separate units, and in the composition of the materials. They differ largely in the fossil content. The Richmond series is divided into four formations with a number of members. The deposits are made up of alternate layers of shale and limestone, generally sharply defined and rather uniformly spaced. The limestone forms 20 to 50 per cent. of the whole. These strata range from 1 in. to 10 in. in thickness, but average from 2 in. to 4 in. The limestone is bluish gray in color, granular but dense in texture, and decidedly siliceous in composition. The stone in the thicker layers is used locally for common masonry purposes.

Medina Series.—The name Medina has been applied to the upper division of rocks in the Ordovician system. The strata consist of shale and sandstone, the latter, however, being found only by the drill under deep covering. In Ohio this sandstone is of special importance over a wide area in the central portion of the state. To the driller it is known as the "Clinton sand" and has produced large volumes of natural gas and much petroleum in a great field extending from Lawrence County on the Ohio River to Cuyahoga County on Lake Erie. The first production was obtained at Lancaster in 1887. The largest gas pools are in Jackson, Vinton, Hocking, Fairfield, Licking, Knox, Holmes, Richland, Ashland, Wayne, Medina Summit and Cuyahoga counties and the main oil pools in Hocking, Perry, Licking, Muskingum, Coshoc-ton, Holmes, and Wayne counties. Scattered production is also present in Athens, Morgan, Tuscarawas, Stark, Portage, Geauga, Lake, and Ashtabula counties. The initial production of the gas wells ranges from 100,000 to 15,000,000 cu. ft. and the rock pressure from 600 to 1,800 lb. The flush production of the oil wells is from 1 to 600 bbl. In general "Clinton" wells are long lived, maintaining a satisfactory yield from 10 to even 20 yr. The depth of drilling varies from 1,000 to 5,000 ft. The field is far from exhaustion as new pools are brought in from year to year.

Brassfield Limestone.—The oldest member of economic importance in the Niagara series of the Silurian system is the Brassfield limestone which is present at the surface in southwestern Ohio. The trend of its outcrop is northeastward from the Indiana-Ohio line near Fairhaven across Preble and Montgomery counties into central Miami County, thence southeastward across Clark, Greene, Clinton, Highland, and Adams counties to the Ohio

River near Rome. The thickness of the Brassfield member is from 20 to 60 ft. with an average around 30 ft. The layers are quite uneven in thickness and in general thin to medium bedded. The partings are thin layers of shaly material quite calcareous in character. The better grades of stone resemble marble in that they are compact and distinctly crystalline. Marine fossils are evident, being most abundant along the partings. The color of the Brassfield limestone changes considerably both locally and regionally. It varies from a very light gray through darker shales of gray, buff, and pink to brownish red. The field of most importance is that along the Miami Valley where the stone is of high purity and where it has been utilized for many years. The character of the stone is shown by the following representative analysis:

	<i>Per Cent.</i>
Ignition loss	42.16
Silica (SiO ₂)	2.84
Alumina (Al ₂ O ₃)	1.33
Ferric oxide (Fe ₂ O ₃)	1.21
Lime (CaO)	48.98
Magnesia (MgO)	3.29
Sulphur trioxide (SO ₃)	trace
Total	99.81

The above is an average analysis of the Brassfield limestone as determined by J. B. Alexander, chief chemist of the Southwestern Portland Cement Co. of Osborn, O.

Formerly the Brassfield limestone was quarried to a small extent for building stone. The chief objection was the irregularity of the layers. The fresh stone is moderately soft and chips readily in any direction. It weathers to a gray color with a rather pleasing tone. The chief use of the Brassfield limestone is for Portland cement for which purpose it is used by two plants near Osborn in Greene County. The product is high grade in every respect. Stone from this member is also used for steel and blast furnace flux, being especially valuable on account of its low silica content. It is employed also to a limited extent for road ballast and agricultural lime.

Under deep covering the Brassfield and Dayton limestones of southwestern Ohio appear to become the "Little Lime" of the driller, lying from 80 to 100 ft. below the base of the "Big Lime" and from 10 to 30 ft. above the "Clinton sand." Further, they probably correlate with the Wolcott and Irondequoit beds of the New York section.

Dayton Limestone.—The Dayton limestone, a small division in the lower part of the Niagara series, was named for the town of Dayton where it was formerly extensively used for building purposes. The deposits are thin, not often exceeding 10 ft. in thickness. Under normal development the member is made up of a number of even bedded layers, varying from 3 in. to 2 ft. in thickness. It is compact, tough, and crystalline and is little affected by weathering agencies. The stone has a uniform color of a light bluish-gray shade when freshly quarried. Locally, at or near the surface, the color

is buff or light yellow. In composition it is a rather pure, high-calcium limestone. The analysis given below is representative:

	<i>Per Cent.</i>
Silica (SiO ₂)	2.04
Alumina (Al ₂ O ₃)	1.05
Ferric oxide (Fe ₂ O ₃)	.15
Calcium carbonate (CaCO ₃)	93.25
Magnesium carbonate (MgCO ₃)	2.82

Although quarried in a relatively small way, the Dayton limestone has been much used as a building material for over eighty years and has proved very satisfactory. It is dressed mainly by chipping, but formerly it was sawed for trimmings, steps, caps, sills, etc. The rough stone has found much use for curbing, flagging, walls, piers, and foundations. Some of the more important quarries are at Centerville and Dayton, in Montgomery County, and near Xenia and Jasper in Greene County.

West Union Member.—The West Union is one of the less important members of the Niagara series, as the formation lacks development over a wide area and as the stone has no special properties for recommendation. The outstanding deposits are in Adams County where the thickness varies erratically from 10 to 80 ft. North of this in Highland County the deposits ordinarily measure less than 10 ft. The member is made up of medium to massive layers, rather regular in formation. The stone is bluish gray in color, compact in texture, and quite siliceous and dolomitic in composition. The following analyses are representative:

	<i>West Union Hillsboro</i>	
Silica (SiO ₂)	24.56	30.12
Alumina (Al ₂ O ₃)	3.06	4.30
Ferric oxide (Fe ₂ O ₃)	2.80	.80
Calcium carbonate (CaCO ₃) ..	39.50	40.20
Magnesium carbonate (MgCO ₃)	29.30	23.50

The West Union limestone has not been extensively quarried at any place in Ohio. Generally it is worked in conjunction with other beds. Its chief utilization has been for crushed stone for road making and railroad ballast. Locally the West Union limestone is employed for building stone.

Springfield Dolomite.—The Springfield dolomite outcrops over a rather wide area in southwestern Ohio in Preble, Montgomery, Miami, Clark, Greene, Clinton, Highland, and Adams counties. The deposits are worked most largely along Mad River in Clark County, along Stillwater Creek in Miami, and along Twin Creek in Preble. The usual thickness of the member is not far from 15 ft. The Springfield member is made up of a number of layers which are rather uniform in lateral extent and which range from 3 in. to 2½ ft. in thickness. The stone has a dull, earthy, porous texture, and frequently has small irregular cavernous openings caused by solution. The usual color is a warm buff or a light brownish yellow. Where unoxidized under deeper covering, the shade is light blue or bluish gray. On exposure in walls, the Springfield dolomite retains its color quite well. The composition is nearly always close to that of a pure dolomite. Locally it is slightly siliceous. The composi-

tion of the typical Springfield dolomite is approximately as follows:

	<i>Per Cent.</i>
Silica (SiO_2)	.65
Alumina (Al_2O_3)	.46
Ferric oxide (Fe_2O_3)	.10
Calcium carbonate (CaCO_3)	54.13
Magnesium carbonate (MgCO_3)	44.37

The Springfield with its associated Cedarville member is worked extensively for caustic and hydrated lime and for crushed stone for road building and for railroad ballast. It is also much used as a building stone, because it holds up well and because the layers are about the proper thickness to meet the common demands. The use of this stone extends to buildings, foundations, curbing, bridges, and heavy masonry. It is also a good flux stone for iron smelting. The worth of the Springfield member is attested by its steady and increased use since the first commercial quarries were opened near Springfield about 1846. It is one of the most important formations in western Ohio.

Cedarville or Guelph Dolomite.—The Cedarville or Guelph dolomite, the youngest member of the Niagara series, is widely exposed in western Ohio. The largest field is in the southwestern part, where the formation is present in parts or in all of Adams, Highland, Clinton, Greene, Fayette, Clark, Champaign, Logan, Montgomery, Miami, Shelby, Auglaize, Preble, Darke, Mercer, and Van Wert counties. The second field is in the north central part of the state where the dolomite outcrops in parts of Marion, Hardin, Wyandot, Hancock, Seneca, Wood, Sandusky, Ottawa, and Lucas counties. The thickness of the Cedarville-Guelph member varies from 10 to 80 ft., but averages nearly 60 ft. In general this dolomite is highly crystalline or has a sugary open texture. Weathering often produces a pronounced honey-comb effect. Usually the member is massive in structure, the entire formation often appearing as a single bed. Elsewhere, however, the rock may be thin to medium bedded, preserving well-defined lines of sedimentation. A representative analysis of Cedarville dolomite follows:

	<i>Per Cent.</i>
Silica (SiO_2)	.88
Alumina and ferric oxide (Al_2O_3 , Fe_2O_3)	.53
Calcium carbonate (CaCO_3)	53.90
Magnesium carbonate (MgCO_3)	44.58

In Ohio the important use of the Cedarville-Guelph dolomite is for lime burning. The product is rated one of the best in the United States for mortars and plasters and has a wide market. The caustic lime disintegrates slowly and the resulting hydrate is unsurpassed for whiteness, has strong bonding powers, has excellent covering capacity, and spreads smoothly. This formation is also worked over a wide area in the western part of the state for railroad ballast, road metal, and concrete aggregate. In general, it serves very well for these purposes. On account of its high purity and its composition this dolomite is used for fluxing purposes in blast furnaces and cupolas. Dolomite refractories or dolomite clinkers for lining basic

hearth steel furnaces are also produced from this stone. Further, it is employed for chemical purposes, agricultural lime, and building stone. The Cedarville-Guelph dolomite is worked in either a large or small way at Peebles, Adams County; Hillsboro, Highland County; Reesville, Melvin, Wilmington, and Port Williams, Clinton County; Clifton, Yellow Springs, and Cedarville, Greene County; Springfield, Cold Springs, and Durbin, Clark County; Phillipsburg, Montgomery County; New Paris and Lewisburg, Preble County; Urbana, Champaign County; Covington and Piqua, Miami County; Gettysburg, Darke County; Celina and Rockford, Mercer County; Patterson, Hardin County; Carey, Wyandot County; Findlay, Hancock County; Tiffin, Maple Grove, Bascom, Fostoria, and Bettsville, Seneca County; Fremont, Woodville, and Gibsonburg, Sandusky County; North Baltimore, Rising Sun, Luckey, and Bowling Green, Wood County; and Genoa, Ottawa County.

Salina Member.—The Salina is the lowest division of the Bass Island or Lower Monroe series of the Silurian system. In Ohio it is represented only under deep covering in the eastern part of the state and is known, therefore, only through drill records and cuttings. The formation consists of a series of shales and dolomites in which from one to many layers of rock salt are interstratified. The evidence, as secured from the drill, indicates that the Salina is from 200 to 600 ft. in thickness in eastern Ohio, but that westward it thins rapidly and disappears before reaching the outcrop in western Ohio. This group of rocks is of interest economically for the salt beds which yield strong brines for making salt, soda ash, and chemicals. As outlined by the drill, the area in which rock salt occurs with more or less constancy is approximately 7,330 sq. mi. in Ashtabula, Lake, Cuyahoga, Geauga, Summit, Trumbull, Portage, Mahoning, Columbiana, Carroll, Jefferson, Lorain, Medina, Wayne, Stark, Tuscarawas, Harrison, and Belmont counties. The western boundary is along a line drawn from Lorain on Lake Erie, through Litchfield, Spencer, Homerville, West Salem, Wooster, Apple Creek, Brewster, Dover, Stillwater, Freeport, and Morristown to Bellaire on the Ohio River. The thickness of individual layers of rock salt varies from 1 to 60 ft. Representative analyses of both the rock salt and of the brine derived therefrom by solution are given below:

	<i>Rock Salt</i>	<i>Brine</i>
Depth	3,510 ft.	1,990 ft.
Specific gravity .....	....	1.204
Grams per kilogram .....	....	264.24
Composition		
Chlorine (Cl)	59.66	59.726
Bromine (Br)	trace	.003
Sulphur tetraoxide (SO_4) ..	.55	1.077
Carbon trioxide (CO_3)	none	....
Hydrogen carbonate (HCO_3) ..	none	....
Sodium (Na)	38.53	38.457
Potassium (K)	.04	.117
Calcium (Ca)	.32	.567
Magnesium (Mg)	none	.038

Alumina and ferric oxide (Al_2O_3 , Fe_2O_3)	.01	.000
Silica (SiO_2)	.20	.000
Strontium (Sr)		.015

Rock salt from Lake Township, Stark County.

Brine from rock salt, Cleveland, Cuyahoga County.

Brines from the solution of rock salt in place, by circulating water through drill holes, are used for commercial salt at Kenmore, Summit County; Rittman, Wayne County; Cleveland, Cuyahoga County; and Wadsworth, Medina County; and for soda ash and chemicals at Fairport, Lake County; and Barberton, Summit County.

Greenfield Member.—The Greenfield formation is best exposed in southern Ohio, the type locality being at Greenfield in northeastern Highland County. From this place the formation extends northwestward and outcrops in a narrow belt across western Fayette, southwestern Logan, northeastern Shelby, central Auglaize, western Allen, northern and central Van Wert, and southern Paulding counties. Much of this belt, however, is deeply buried with glacial drift, hence the stone is seldom exposed. In the northern part of the state the Greenfield formation appears also on the flanks of the Cincinnati Arch in Ottawa, eastern Lucas, eastern Wood, central Sandusky, central Hancock, western Wyandot, and southeastern Hardin counties. This formation is from 75 to 100 ft. in thickness.

The Greenfield is close to a true dolomite in composition, varies from a light drab to a yellowish brown color, and is fine grained but often vesicular in texture. It occurs in layers which vary from 2 to 14 in. in thickness, but which usually range between 4 and 8 in. The beds are regular and uniform in thickness, thus favoring its use for building stone.

The following analysis is representative:

	Per Cent.
Silica (SiO_2)	7.16
Alumina (Al_2O_3)	2.19
Ferric oxide (Fe_2O_3)	1.05
Calcium carbonate (CaCO_3)	49.95
Magnesium carbonate (MgCO_3)	39.42

Formerly the Greenfield dolomite was well liked and used rather widely for building stone, but at present it finds only a local market. It is worked in a large way, however, for railroad ballast, for road metal, and for concrete work.

Tymochtee Member.—The Tymochtee member of the Bass Island group, named from exposures on Tymochtee Creek in Wyandot County, is quite widely distributed in western Ohio. It forms the bed rock in large areas in Fayette, Madison, Champagn, Union, Logan, Hardin, Wyandot, Allen, Hancock, Putnam, Paulding, Wood, and Lucas counties and in small areas in Clark, Marion, Auglaize, Seneca, Sandusky, Ottawa, and Henry counties. The formation is approximately 150 ft. in thickness and is made up of thin-bedded layers of dolomite separated by partings of shale which are calcareous and decidedly carbonaceous in character. The color of the stone varies from gray to shades

of brown, depending on the degree of weathering. This dolomite is close grained, fairly tough, and moderately homogenous. The following analyses show the general composition of the Tymochtee dolomite:

	Buff stone	Blue stone
Silica (SiO_2)	3.06	1.80
Alumina (Al_2O_3)	2.10	1.04
Ferric oxide (Fe_2O_3)	trace	trace
Calcium carbonate (CaCO_3)	52.55	53.50
Magnesium carbonate (MgCO_3)	42.12	43.10

The main use for this stone is for road and railroad ballast. Formerly it was used locally for rough masonry and to some extent for lime burning. Representative quarries are found at the following places: North Baltimore, Waterville, Holland, Tiffin, Middlepoint, Dunkirk, Lima, Lafayette, Ada, and Rushmore.

Put-in-Bay Member.—In Ohio the known deposits of Put-in-Bay dolomite are limited to a rather small area consisting of South Bass Island, Catawba Island, and adjacent parts of the mainland near Marblehead and Crystal Rock Hill. West of the Cincinnati Arch it is found west of Toledo, appearing in the quarry at Holland. Measurements indicate that the Put-in-Bay formation is close to 50 ft. in thickness. This dolomite is gray to drab in color, crystalline and open in texture, and about average in purity. It has been utilized to only a small extent.

Raisin River Member.—The Raisin River member is of small importance in Ohio as the known deposits are confined to small areas west of Toledo and to the Bass Islands of Lake Erie. It is an argillaceous dolomite of the usual blue gray to drab color. The rock is commonly divided into layers 2 to 6 in. in thickness, but locally it assumes more massive character. It is best exposed in the Holland quarry west of Toledo.

Sylvania Sandstone.—As known, the outcrops of the Sylvania sandstone are confined to northwestern Ohio. Locally this sandstone is exposed in a narrow belt extending across the northwestern part of Lucas County. The deposits lay unconformably upon the Raisin River dolomite, but merge into the Amherstburg member above. The stratum is very erratic in thickness, varying from 1 ft. or less to 40 ft. or more. The sand grains are fine in texture, even in size, well rounded, loosely cemented, and quite pure quartz. The cement is largely dolomitic matter. Formerly the Sylvania sandstone at Sylvania was utilized for glass sand.

Amherstburg Member.—The Amherstburg member of the Detroit River group is confined to northern Ohio in two areas, one east of the Cincinnati Arch in Ottawa, Erie, and Sandusky counties and another west of this structure in Lucas, Wood, and Henry counties. It is a true dolomite in composition, drab to brownish in color, open or even cavernous in texture, and quite massive in bedding. Owing to the thick mantle of drift and the sparsity of exposures, the thickness of the formation is not definitely fixed, but appears to vary between 50 and

100 ft. Where utilized it is quarried with the overlying Lucas which it resembles in many respects. The most typical exposures are along the lake front on the north of Marblehead Peninsula in Ottawa County.

Ohio produces annually nearly 350,000 tons of gypsum which has a value of over \$3,300,000. Gypsum, or the mineral calcium sulphate, was formed where a part of the sea was detached, thus making a salt water lake and thus allowing evaporation to produce precipitation of the salt. The area where gypsum is found in the limestones is not large, in fact it is only a few square miles in extent and is confined to that portion of Ottawa County lying between Lake Erie and Sandusky Bay. The rock is mined both by stripping and by drifting. The stone is then graded, crushed, and calcined, when the product becomes the plaster-of-Paris of commerce. It is used extensively for fertilizer, fireproofing, wall board, stucco, white wash, plaster, pottery molds, statuary, crayons, retarder for Portland cement, and many other purposes.

Lucas Dolomite.—The best development of the Lucas member in Ohio is in the northwestern part of the state in western Lucas, northwestern Wood, and southeastern Henry counties. The maximum thickness here is over 140 ft. On the eastern flank of the Cincinnati Arch it appears again in eastern Ottawa, western Erie, and southeastern Sandusky counties. The sections exposed are from 30 to 75 ft. in thickness. The Lucas is characteristically a dolomite, but locally somewhat calcareous in nature. The formation is generally definitely bedded, the layers usually ranging between 3 and 12 in. in thickness. The stone varies in color from light blue to drab, depending on the state of oxidation of the iron minerals. The usual composition of the Lucas dolomite is represented by the following analysis from a sample at a quarry in Bellevue in Sandusky County:

	<i>Per Cent.</i>
Silica (SiO ₂)	5.24
Alumina (Al ₂ O ₃)	.96
Ferric oxide (Fe ₂ O ₃)	trace
Calcium carbonate (CaCO ₃)	56.30
Magnesium carbonate (MgCO ₃)	37.91

As the area of outcrop of the Lucas and Amherstburg formations is not large, they are not important sources of operation. Some of the largest quarries are the Toledo Stone Co. at Silica, Lucas County; Wilson Stone Co. near Castalia in Erie County; and the Bellevue Stone Co. at Bellevue in Sandusky County. The chief output is crushed stone for road work, ballast, etc.

Oriskany Formation.—In Ohio the Oriskany formation is known only under deep covering in the eastern part of the state where it is reached by the drill in the search for oil and gas. It is very patchy in development, being wanting or at least unrecognizable over large areas. The thickness of the deposits as revealed by the drill varies from 1 to 100 ft., but the average measurement is between 10 and 30 ft. The material is a fine round-grained sandstone, loosely cemented with a calcareous bond. So far the production in the Oriskany sandstone has

been largely gas. This formation is reached at 1,950 ft. in the Austinburg pool of Ashtabula County; at 3,400 ft. in the Cambridge field of Guernsey County; at 3,700 ft. in West Township, Columbiana County; and 5,200 ft. near Steubenville, Jefferson County.

Columbus Formation.—The Columbus limestone, the major division of the Corniferous of the early surveys, outcrops in a broad belt from 10 to 25 mi. in width and nearly 150 mi. in length. This field extends from Pickaway County on the south through western Franklin, eastern Union, western Delaware, eastern Marion, eastern Wyandot, western Crawford, eastern Seneca, southeastern Sandusky, and western Erie to the tip of Marblehead Peninsula in Ottawa County. The second field is a crescent-shaped area in northwestern Ohio on the west flank of the Cincinnati Arch. It extends from northern Paulding County through southeastern Defiance, northwestern Putnam, central Henry, and northwestern Wood counties to western Lucas. The third area lies around the Bellefontaine outlier in eastern Logan and north central Champaign counties.

In general the Columbus is massive in bedding, somewhat earthy in appearance, and light gray to buff in color. The composition varies not only with locality, but with the different layers. It changes from a low magnesium limestone to a calciferous dolomite. Locally chert is present either in layers or as scattered nodules. The thickness of the formation varies from 40 to 60 ft. in the Bellefontaine outlier to 80 to 120 ft. in the central Ohio field. The average composition of the Columbus formation is shown by the following analyses:

	<i>Columbus (Franklin County)</i>	<i>Marble- head (Ottawa County)</i>	<i>White- house (Lucas County)</i>
Silica (SiO ₂)	2.30	1.83	1.66
Alumina (Al ₂ O ₃)	.70	.40	.96
Ferric oxide (Fe ₂ O ₃) ..	.52	.32	.10
Calcium carbonate (CaCO ₃)	90.16	83.22	74.52
Magnesium carbonate (MgCO ₃)	5.90	14.29	23.50

The Columbus stone has been used extensively for a wide range of purposes. When properly selected it is a building stone of fair quality and with a pleasing appearance. It is fairly resistant to weathering as shown in the State House at Columbus. It is employed also for heavy masonry in piers, docks, and breakwaters along the lake front; in bridge foundations and abutments of road work; and for foundations, retaining walls, steps, cellars, etc., of general building. Such stone is supplied mainly from quarries at Columbus, Delaware, Owens, Marion, Marblehead, and Kelley Island.

On account of quality, ease of quarrying and crushing, and favorable location, the Columbus limestone is employed extensively for crushed stone for railroad, road, and concrete work. Quarries are well distributed over the entire outcrop of the member, but the principal ones are located at Columbus, Delaware, Bellepoint, White Sulphur,

Marion, Owens, Bloomville, Marblehead, Kelley Island, and Whitehouse.

The Columbus limestone, on account of its high calcium content, produces a hot, quick slaking lime useful for mortars and for agricultural purposes in correcting the acidity of soils. Quick and hydrated limes are produced at Delaware, Owens, Marion, and Marblehead. The iron industry has drawn enormous quantities of flux stone from the Columbus formation. It is mined mainly at Kelley Island, Marblehead, Marion, Owens, and Columbus and supplies furnaces at Pittsburgh, Sharon, New Castle, Leetonia, Hubbard, Niles, Warren, Massillon, Youngstown, Cleveland, Lorain, Columbus, Portsmouth, and Ashland. Stone from this formation when properly prepared is also used for Portland cement, paint pigment, and glass making.

Delaware Limestone.—The Delaware formation, or its equivalent in time, is present in two areas in Ohio. The main field is in the central part of the state in a long narrow belt extending from western Pickaway County northward past Columbus, Delaware, Marion, and Bellevue to Sandusky on Lake Erie. The other area is in northwestern Ohio in western Lucas, northwestern Wood, central Henry, southern Defiance, and northern Paulding counties. Here the deposits are known as the Traverse and are equivalent in time to the Delaware and Olentangy of central Ohio. This formation is completely wanting in the Bellefontaine outlier in Logan County as there the Columbus limestone is directly overlain by the Ohio shale.

The Delaware formation ranges from 30 to 50 ft. in thickness, but averages close to 45 ft. It varies in character from shales with thin limestone layers to limestones with only bedding plane partings of shaly material. The best stone is in the area from Delaware northward to Sandusky. In general the limestone layers are rather even bedded and from 2 to 12 in. in thickness. Locally some of the layers thicken to 18 or even 24 in. The normal color of the Delaware limestone is from light to dark bluish gray. Through weathering, yellowish and brownish shades are locally developed near the surface. The composition is shown by the following analysis of a sample taken at Delaware:

	<i>Per Cent.</i>
Silica (SiO ₂)	10.36
Alumina (Al ₂ O ₃)	2.71
Ferric oxide (Fe ₂ O ₃)	.05
Calcium carbonate (CaCO ₃)	69.80
Magnesium carbonate (MgCO ₃)	17.21

The Delaware ranks as a good building stone and has been used quite extensively for many years both for architectural work and for heavy masonry. The stone is dense, tough, and durable. The evenness of bedding is an aid in quarrying the stone into sizes convenient for such work. This formation is further largely drawn upon for crushed stone for railroad ballast, road metal, concrete aggregate, etc. Hydrated and quick lime are also produced at a few places. The principal centers of quarrying are at Delaware, Marion, Bloomville, Bellevue, and Sandusky.

Olentangy Shale.—The Olentangy formation lying above the Delaware limestone and below the Ohio shale is a gray, siliceous, calcareous shale with plastic clay-like properties. Where typically developed the stratum varies from 20 to 35 ft. in thickness. At present it is of no practical importance, but formerly was worked at Delaware for building block and drain tile.

Ohio Formation.—The Ohio, the upper division of the Devonian system, is made up of three members, Huron, Chagrin, and Cleveland. These units, however, are not sharply defined and regionally are quite variable. The Huron and Cleveland are typically black fissile shales with a high content of carbonaceous matter in a fine state of division. The Chagrin, or middle unit, is a gray, siliceous shale, differing from the others through lack of organic matter. The Ohio shale outcrops in three widely separated areas in Ohio. The main field crosses the central part of the state in a belt from 8 to 20 mi. in width. It extends from Adams County on the Ohio River to Erie County on Lake Erie, thence eastward along the lake front to Ashtabula County. The second field, largely buried by glacial drift, is present in northwestern Ohio in western Lucas, eastern Fulton, northwestern Henry, northern Defiance, and southern Williams counties. The remaining area, which is much smaller in size, is found around the Bellefontaine outlier in Logan County.

This division of rocks varies from less than 400 feet in thickness in Pike County to more than 2,800 ft. in Jefferson County. Normally these shales thicken from 20 to 30 ft. per mi. to the east, and from 5 to 15 ft. per mi. to the south. These black shales are interesting, for during the early 1850's they were utilized at Buena Vista for the distillation of kerosene. Far in the future they may again be employed for their yield of oil and gas. At present, through drilling, the Ohio shale yields small volumes of natural gas in a few areas. In northern Ohio, especially in the Cleveland district, the Chagrin and Cleveland members are utilized for ceramic products such as building brick, building block, and drain tile. Black, carbonaceous shale from this formation in Logan County is used for the acid ingredients and for its fuel value in the manufacture of Portland cement at Osborn.

Bedford Formation.—The Bedford is the oldest formation of the Mississippian system and really inaugurates the beginning of a large series of siliceous deposits, including a variety of shales and sandstones. These rocks are of marine origin and were laid down in quiet shallow water. The formation is made up largely of shales which vary in character from soft clay-like material of a pink, mottled, or chocolate color to hard siliceous shale of light gray to dark bluish gray shades. In the Cleveland district a group of sandstone layers known as the Euclid lentil appears in the basal portion of the formation. In southern Ohio the soft pink shale is absent and the gray shale becomes decidedly siliceous, in fact it contains many thin layers of ripple marked sandstone. The Bedford formation out-

crops in a narrow belt extending from the Ohio River near Buena Vista in Scioto County to Lake Erie near Lorain, thence eastward to the Ohio-Pennsylvania line in southern Ashtabula County. It varies in thickness from 50 to 110 ft., but averages close to 85 ft. Local supplies of building stone are quarried from the Euclid lentil in the Cleveland district. The stone is of good quality for flagging, sills, caps, and general masonry. Locally both the gray and pink shales are utilized for ceramic purposes. The chief operations are near Chillicothe, Columbus, Galena, and Cleveland. The product is building brick, fireproofing, building block, and drain tile.

Berea Formation.—The Berea is one of the well known deposits in Ohio, for it is important as a source of abrasives and building stone and as an oil sand for the production of petroleum and natural gas. It is very persistent across the eastern part of Ohio, seldom being wanting even locally. The deposits, however, vary considerably in thickness and in character. The formation expands irregularly from 5 to 225 ft., but averages close to 45 ft. The stone in the type localities, which are the thick deposits of northern Ohio, is massive in structure, medium coarse in grain size, and rather open in texture. Although the bonding components are rather low, the stone is well cemented and durable. Cross-bedding planes and ripple marks are common features. The color, normally a light gray, changes to a slightly yellowish tint on protracted weathering. In the average deposits of the state, where the formation is from 20 to 60 ft. in thickness, the characteristics are somewhat different. The deposits are made up of sandstone layers which vary from 2 in. to 3 ft. in thickness and which are separated by shale measuring from 1 in. to 2 ft. Most of the layers maintain fair lateral uniformity, but quite frequently some beds are broken into lens-like or even concretionary masses. In this type of Berea sandstone, the sand grains are rather fine and uniform in size and the bonding component, consisting largely of clay matter and iron minerals, is from 10 to 20 per cent. of the whole. The following analyses are representative:

	<i>Berea</i> (<i>Cuyahoga</i> County)	<i>Waverly</i> (<i>Pike</i> County)
Silica (SiO ₂)	93.13	91.00
Alumina (Al ₂ O ₃)	3.86	5.20
Ferric oxide (Fe ₂ O ₃)	.11	.30
Ferrous oxide (FeO)	.54	1.17
Magnesium oxide (MgO)	.25	.28
Calcium oxide (CaO)	.19	trace
Ignition loss	1.43	1.80
	99.51	99.75

The Berea sandstone has had a long and continued use as it makes a good appearance, has excellent strength, and is quite weather resistant. It quarries with good economy and works readily either by chipping or by sawing. The Berea stone is employed in a wide variety of ways, chief of which are for building, flagging, curbing, bridge, grind-

stone, whetstone, breakwater, ballast, and road purposes. The most prominent quarries are confined mainly to northern Ohio at or near South Amherst, Kipton, Columbia, Amherst, Oberlin, Grafton, Elyria, and Ridgeville, Lorain County; Birmingham, Berlin Heights, and Wakeman, Erie County; Berea, West View, South Euclid, and North Olmsted, Cuyahoga County; Peninsula, Summit County; and Mount Gilead and Fulton in Morrow County. It is worked in a small desultory way also in Trumbull, Ashtabula, Geauga, Huron, Crawford, Franklin, Ross, Pike, and Scioto counties.

The Berea ranks third in the productive oil and gas sands of the state, being surpassed only by the Trenton and the Clinton. The yield has been largely oil. The depth of the wells varies from 100 to 2,000 ft., but the usual range is between 500 and 1,500 ft. On the average the wells are not large producers, but are long lived. The larger pools are in Athens, Washington, Perry, Morgan, Muskingum, Noble, Monroe, Belmont, Harrison, Jefferson, Carroll, and Columbiana counties. Some production is also obtained in Gallia, Meigs, Vinton, Hocking, Guernsey, Coshocton, Tuscarawas, Holmes, Stark, and Mahoning counties.

Sunbury Formation.—The Sunbury shale, lying directly above the Berea sandstone, is a persistent bed in eastern Ohio. Its range of outcrop is from Scioto County on the south to Lorain County on the north, thence to Ashtabula County on the east. This shale is high in carbonaceous matter, is brown to black in color, is close in texture, and fissile and laminated in structure. The fossil content indicates marine origin. The thickness of the stratum is from 12 to 35 ft., with an average of close to 20 ft. At present the Sunbury shale is of no economic importance, but is interesting as it is a good bench for reference in stratigraphic work.

Cuyahoga Formation.—The Cuyahoga formation is highly variable both laterally and vertically when more than a local area is considered. The units in southern Ohio are much different from those in central Ohio and these in turn suffer many changes in their extension into northern Ohio. These changes are due to the manner of deposition. The strata in the Cuyahoga formation are of marine origin and were laid down off shore where the conditions of depth, strength of currents, kind, amount and source of silts, and other factors were undergoing severe modifications. In this discussion only a few of the more important members need to be considered. The deposits of most worth are the Buena Vista sandstones and the Portsmouth shale of southern Ohio, the Black Hand sandstone of central Ohio, and the Orangeville shale of northern Ohio.

The Buena Vista member is made up of a great series of sandstone and shale layers occupying from 100 to 150 ft. of the lower part of the Cuyahoga formation in southern Ohio in western Scioto, eastern Adams, and western Pike counties. The sandstone beds vary from 1 in. to 6 ft. in thickness, but the majority are under 16 in. Further, they maintain remarkable regularity in their lateral extension. These sandstones are fine in texture, break

well in any direction, are bluish gray in color, and are firmly cemented with clay matter and iron minerals. The following analysis is representative of the stone at McDermott:

	<i>Per Cent.</i>
Silica (SiO ₂)	85.60
Alumina (Al ₂ O ₃)	7.25
Ferric oxide (Fe ₂ O ₃)	2.60
Titanic oxide (TiO ₂)	.75
Calcium oxide (CaO)	trace
Magnesium oxide (MgO)	trace
Loss on ignition	1.70

The shales intervening between the sandstone layers have a wider variation in thickness, some being mere partings, whereas others are massive beds of many feet. Where the sandstone layers are thick and closely spaced, they offer excellent opportunities for quarry operations. At present activity is largely confined to McDermott in Scioto County. Formerly, however, the deposits were worked in a large way at Buena Vista, Rarden, and Henley in Scioto County and at Waverly in Pike. The output consists of sawed stone for building, grave vault, flagging, curbing, and other purposes and rough stone for bridges, abutments, retaining walls, and foundations.

The Portsmouth is a shade member about 250 ft. in thickness and best represented in the Portsmouth district of Scioto County. The stone is massive in development, uniform in character, siliceous in composition, dark bluish gray in color, and poorly marked by lamination. As shown by the fossils it is of marine origin. The Portsmouth shale is standard for the manufacture of paving block and is also regularly employed for building brick and roofing tile. The operations are centered around Portsmouth in Scioto County.

The Black Hand member forms conspicuous deposits in central Ohio in Hocking, Fairfield, Licking, and Knox counties and extends eastward under deep covering into West Virginia. It is a massive deposit, often one great ledge, and it varies in thickness from 50 to 200 feet or more. The stone changes in texture from a coarse grained sandstone to a rather pebbly conglomerate. It is generally highly cross-bedded, the planes being confined to definite boundaries which are rather closely spaced. The cementing medium is largely iron oxide. This sandstone is commonly of a decided buff color, but locally it changes to shades of gray, pink, or brown.

The Black Hand member is of economic value as a building material, as a source for sand, as a reservoir for the accumulation of oil and gas, and as a deep-seated basin for brines. For building purposes this stone is at its best along the Licking River in eastern Licking County, where it was worked at Hanover and Toboso, and along the Hocking River in southern Fairfield and northern Hocking counties, where it was worked at Lancaster, Sugar Grove, Rockbridge, and Logan. Active operations are now confined to Sugar Grove where stone of an excellent quality and an attractive color is prepared for the market. Through crushing followed by screening, air separation, or washing, the Black Hand sandstone finds a good

market for such purposes as molding sand, mortar sand, sand finish of plastering, sand blasting, engine sand, and glass sand. Plants of this kind are present at Sugar Grove in Fairfield County, at Black Hand in Licking County, and at Millwood in Knox County. To the driller for oil and gas the Black Hand sandstone is known as the Big Injun. In Ohio production has been obtained from this stratum in Washington, Noble, Monroe, Belmont, and Jefferson counties. In the Pomeroy district of Meigs County, the Black Hand sandstone is one of the important sources of brines for the salt industry. It yields a large flow of concentrated brine which is high in bromine and practically free from sulphates.

The Breaksville shale of the Orangeville member is confined to northeastern Ohio. It is best exposed along the valleys in the Cleveland district where the deposits have a total thickness of about 100 ft. This shale is rather homogenous in character, is black to bluish gray in color, is soft and clay-like in texture, and has been utilized to some extent for ceramic products. Shales of the Cuyahoga formation are also worked for brick making at Wooster and Mansfield.

Logan Formation.—The Logan formation consists of four members which in ascending order are Berne, Byer, Allensville, and Vinton. It is made up of shales, sandstones, and conglomerates and has a range from the Ohio River in Scioto County northward across the state to Akron in Summit County beyond which it thins rapidly and soon becomes wanting. The thickness of these rocks varies from about 100 ft. at Portsmouth in Scioto County to 260 ft. at Wooster in Wayne County. They have little economic value.

The Berne member varies from a shaly sandstone, through coarse grained sandstone to a true conglomerate. The stone is of marine origin as is attested by the well preserved fossils. The stratum lacks continuity and is always thin. The measurements vary from a few inches to 15 ft., but average less than 2 ft. The bed is of interest chiefly as a stratigraphic unit.

The Byer at the type locality, Byer in northern Jackson County, is a fine grained, even bedded, sandstone of a yellow or buff color. The bonding components, consisting of clay, water, and iron minerals, are rather high, but the stone is only locally weather resistant. In some areas much of the sandstone is replaced by gray siliceous shale. The thickness of the Byer member is about 60 ft. in Scioto County, 70 ft. in Vinton, 100 ft. in Ross, and 70 ft. in Wayne. It is of small worth, supplying only small quantities of building stone for local needs.

The third unit in the Logan formation is the Allensville member which is quite distinctive in that it is a fine but very even grained conglomerate, often present in two separate beds. Associated and interstratified with the conglomerate is more or less shale and sandstone of the ordinary Waverly types. The Allensville member is recognized along the outcrop from Scioto to Summit County. The

thickness of the conglomerate zones is from 1 in. to 4 ft. and that of the entire member from 2 to 25 ft. If present in larger quantities, the well sorted conglomerate would be useful for several purposes.

The youngest deposits in this group of rocks are those of the Vinton member which was named for exposures in the western part of Vinton County. Here it is made up of a series of sandstones and shales, but elsewhere it may vary from massive sandstone with little or no shale to shale with only thin lenses of sandstone. The sandstones are fine grained, thin to massive bedded, and gray to drab in color. The shales are always siliceous in character and of the usual color, gray or drab, depending on the amount of weathering. Locally some fossils are present. The thickness of the deposits varies from 5 to 180 ft., depending on the amount left by the erosion cycle at the close of Mississippian time. The shales of the Vinton member are very satisfactory for ceramic products, such as building brick and paving block. They are utilized at Junction City in Perry County, Hanover in Licking, and Wadsworth in Medina. Under deep covering in eastern Ohio, the Vinton sandstone becomes the Keener sand of the driller and is important as a source of oil and gas in Jefferson, Belmont, Monroe, Harrison, Washington, Noble, and Morgan counties.

Maxville Formation.—Through crustal movements and erosion, the Maxville limestone was removed from much of the area over which it is due in eastern Ohio. The deposits remaining are local and scattered. Near the outcrop the only areas of any importance are one in southern Ohio and another in the east central part of the state. The former extends irregularly from the Ohio River near Ironton northwestward past Mount Vernon, Olive, and Bloom furnaces to the head of the Dever Valley in the southwestern corner of Jackson County.

Here the stone is under shallow covering and is reached by a shaft at Ironton and by drill tests at other places. The deposits vary in thickness from 1 to 120 ft. The limestone appears to be massive bedded, but in reality it is broken every few inches by a papery parting of calcareous shale. The rock is dense and brittle in character and light gray in color. On account of its low content of silica, alumina, sulphur, and magnesia, it has a wide range of usefulness, chief of which are Portland cement, quick lime, flux for steel and iron furnaces, and lime for chemical industries, agricultural purposes, and glass making. The main area of Maxville limestone in central Ohio extends irregularly from the outcrop at Maxville in southwestern Perry County, northeastward past Crooksville and Roseville to where it appears along Jonathan Creek in southwestern Muskingum County. Ordinarily the thickness here is between 15 and 50 ft. The stone is medium to massive bedded, dense, and strong. At present it is regularly employed for Portland cement and for glass making, but formerly it was used for building purposes and for quick lime. The following analyses are representative:

	<i>Ironton Fultonham</i>	
Silica (SiO ₂)	2.50	3.20
Alumina (Al ₂ O ₃)	.40	.49
Ferric oxide (Fe ₂ O ₃)	.10	1.10
Calcium carbonate (CaCO ₃)	96.20	94.46
Magnesium carbonate (MgCO ₃)	.85	.072
Phosphorous (P)	.005	.027
Sulphur (S)	trace	.10

Under deep covering the Maxville limestone is present with more regularity and with excellent thickness in Morgan, Noble, Washington, and Monroe counties. In its extension southward into West Virginia, it becomes the Greenbrier or Mountain limestone and westward into the Mississippi Valley it forms a part of the Chester group.

Illinois Geological Survey to Make Thorough Study of Resources

A new mineral-research program has been inaugurated by the Illinois State Geological Survey, under the leadership of Dr. M. M. Leighton, Chief of the Division.

The research program provides for a complete scientific investigation into the composition and potential economic possibilities of all mineral and rock substances occurring in Illinois, and also provides for the study of production and movements of mineral materials both into and out of the state, and of all possible marketing opportunities.

The Geological Survey's staff has been greatly enlarged in order to carry out these researches, a trained corps of chemists and physicists having been appointed to cooperate with the regular geologic staff in this respect.

Investigations will be carried on in the new mineral research laboratories, recently dedicated, which have been provided by the University of Illinois adjacent to the Geological Survey offices in Urbana, Ill.

Among the leading rock and mineral substances which will come in for scientific investigation are: clay, shale, limestone, sandstone, sand and gravel, molding sand, fullers' earth, fluorspar, silica sand, tripoli, and ochre.

During its 26 years of geologic field investigations the Survey has outlined tremendous reserves of these natural earth substances, which need the proposed research to reveal their true nature and value for many uses in the chemical, metallurgical, structural, power and agricultural industries.

The research program, as outlined above, is the outgrowth of organized activity on the part of the Illinois Mineral Industries Committee, which was formed in 1930 for the purpose of putting the plan into effect by securing favorable legislation and adequate appropriations, after the proposal was approved by the Illinois Board of Natural Resources and Conservation.

Besides making detailed studies of individual mineral substances, attention will also be given to the possibility of blending different mineral and rock substances for the manufacture of commercial products not now being produced.

Methods and Costs of Quarrying, Crushing and Grinding Limestone*



**Catskill, N. Y., Plant,
North American
Cement Corp.**

THE first prospecting on the property of the North American Cement Corp. at Catskill, N. Y., was done in 1914 and 1915, and quarrying operations were started in February, 1916. During the early operation of the quarry, drilling was done by tripod drills and all stone was loaded by hand. Transition to the modern methods of quarrying, to be described subsequently, was made gradually.

The Devonian beds in which the quarrying operations are conducted are folded into a series of anticlines and synclines, with the folds strongly developed along a general north-south strike. Another series of folds has an east-west strike, but is not so pronounced. The formations are disturbed by a series of overthrusts, rather closely spaced and having an easterly dip. The overburden varies from 0 to 5 ft. in thickness and consists of glacial sand and clay deposits with a small amount of siliceous material from the Oriskany.

The limestone is of the following designations: Esopus, Alsen, Becraft, New Scotland, and Coeymans. The Becraft beds are high in calcium carbonate, and quarrying operations are conducted largely in them, with the method of quarrying determined by their position. Fig. 1 shows an elevation of the quarry with the limits of the present working face.

The vertically dipping Becraft stone at the east end of the quarry is difficult to drill due to seams, faults, and an occasional small cave. Toward the west, where the dip is not so steep, drilling is less difficult, although the greater hardness of the New Scotland stone underlying the Becraft at the western end of the quarry slows up drilling. About one hole out of ten is lost, due to broken drills, seams causing the drill to lose direction, etc. Most of the trouble is encountered in the vertically folded stone at the east end of the quarry.

As stated, the first prospecting on the property was done in 1914. Holes were put down with a shot drill and the core samples obtained were analyzed

by R. W. Hunt & Co. of New York.

Prospecting for the second (North) quarry was done in 1920. In this instance well drills were used and sludge samples taken at every 4 ft. of depth. The holes were spaced about 30 ft. apart across the rock fold and 100 ft. apart along the fold, and varied in depth from 60 to 100 ft.

Prospecting for the present (South) quarry was started April 17, 1925, and is still being carried on at intervals when drilled reserves require extension. Thus far, 85 well-drill holes ranging from 60 to 110 ft. deep have been sunk. The spacing of these holes is irregular and was made to suit the

known approximate strike of the rock folds. As a general thing the position of holes was restricted to points where the Becraft limestone was not exposed or where there was doubt about the grade of rock underlying the surface. Samples of drill-muds are taken at 5-ft. intervals and are analyzed for calcium-carbonate content, with complete analyses when considered necessary.

Prospecting is done when convenient as a matter of routine and is kept about 400 ft. in advance of the quarry face. After major jobs of prospecting, estimates of reserves are made by plotting the holes to scale on cross-section paper, and considering dip, average thickness, and length of formations, and calculating the contents of the proved ground in cubic yards. The tonnage is figured by assuming a weight of 125 lb. per cubic foot. For convenience, the stone is considered to be of two grades: one containing 80 to 100 per cent. of CaCO_3 , and the other from 60 to 80 per cent. of CaCO_3 .

Fig. 2 shows a plan of the quarry and track. The quarry face is approximately normal to the strike of the folding. The present working face runs nearly east and west, and is about 500 ft. long by 60 to 84 ft. high. The quarry is served by a single-loop standard-gauge track. The primary crusher is situated approximately north of the working face and about half a mile distant.

The light overburden, varying from 0 to 5 ft., is not removed by stripping, but is shot down and handled with the stone. It is highly siliceous, and silica is a necessary component for the cement mixture. The percentage composition of the overburden is as follows: CaO , 5.5; SiO_2 , 59.8; Fe_2O_3 , 6.4; Al_2O_3 , 14.3; MgO , 2.9; loss on ignition, 10.0; undetermined, 1.1. The ratio of overburden to stone is about 1 to 50 by weight. There is natural drainage from the quarry, so no provisions for taking care of water are required.

Quarrying operations are confined to materials suitable for the cement mixture, so there is no waste from the quarry, all the stone going to the mill. The output varies from 1,500 tons per day for full mill operation to 1,000 tons per day for re-

* Reprinted from U. S. Bureau of Mines Information Circular 6522.

stricted operation. The overburden included in this output is about 2 per cent. of the total tonnage. The quarry operates in the daylight hours only and averages about 10½ hr. a day.

Drilling.—Three Loomis Clipper drills, of traction type, are used for primary drilling. A description of them follows: 1 No. 4ET, type AVE, powered by a 15-hp. electric induction motor; 1 No. 4ET, type AVE, powered by an 11-hp. electric induction motor; 1 No. 4GT, type JS, powered by an 18-hp. Cook gasoline engine.

The electric drills are liked best because they are easily started in cold weather and because it is not necessary to haul gasoline and water to them. But since it is inconvenient to operate them at points

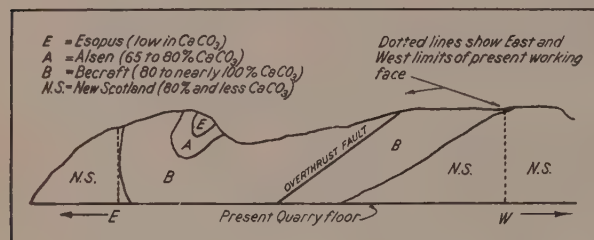


Fig. 1. Elevation of the quarry, looking south.

far from the electric power lines, the gasoline drill is used for prospecting. Comparative figures for operating costs of the different drills are not available, but the following figures of performance during 1930 should be interesting:

Drill	Total feet drilled	Hours operated	Feet per hour
15-hp. electric	5,762	1,592	3.62
11-hp. electric	3,927	1,514	2.59
18-hp. gasoline	2,806	1,119	2.51
Total	12,495	4,225	Average 2.96

The bits used with the drills are of the Gill type, and vary in diameter from 5½ in. for the smallest to 6¼ in. for the largest; they are all about 4 ft. long. The holes drilled are about 6 in. in diameter and extend to a point 6 or 8 ft. below the quarry floor. The holes for primary blasting are spaced about 30 ft. back from the quarry face and 16 to 18 ft. apart. The spacing is controlled by the required fragmentation, the height of face, and the hardness of rock. The present practice in spacing holes was developed by experimenting over a period of about 18 months, during which time six primary blasts were set off. Distances between holes ranging from 16 to 22 ft. and distances from face to holes ranging from 20 to 32 ft. were tried, one set of measurements being used for one blast so that there was no chance for confusion through using several different spacings in one blast. After calculating the tonnage shot down against the fragmentation and ease of cleaning up the shots, the present spacings were adopted as standard. A 7-in. iron pipe 6 to 7 ft. long is used to case through the light overburden during drilling.

Secondary drilling for breaking boulders is done by jackhammer drills, using ⅞-in. hexagon bits, varying in length from 2 to 14 ft. Compressed air having a pressure of 70 lb. per sq. in. is used.

Blasting.—Twenty or more holes are loaded for each primary blast. A crew of 10 men handles the routine of loading, which is about as follows: 3 men truck dynamite from the magazine to a position near the holes, 3 men carry dynamite and earth for tamping to the holes, and 4 men load the holes. It takes about one-half hour to load each hole.

No springing of holes is done. Where the rock is hard and solid the hole may be completely filled with dynamite, but for less solid rock the dynamite is alternated with 5 or 6 ft. of dirt, so placed that the dirt plugs in adjoining holes will be at different levels. At the bottom of every second hole and in all holes at the end of the straight section of the working face, where it curves from an east-west direction toward a north-south direction, 100 lb. of 75-per cent. quarry gelatin is used. Clay is used for tamping in summer, and stone screenings in winter.

No. 6 Hercules exploders, with plain and covered cordeau, detonate the primary blasts. No. 6 Hercules exploders are used for secondary blasts. The following figures show the quality and quantity of dynamite used in 1930:

Total stone quarried in 1930 . . . 281,400 short tons
Dynamite used for primary blasting (sticks 5 in. × 16 in. or 24 in.) :

75-per cent. quarry gelatin	11,250 lb.
60-per cent. quarry gelatin	30,850 lb.
60-per cent. Red Cross	37,800 lb.
60-per cent. Gelex A	9,050 lb.

Total	88,950 lb.
Stone blasted per lb. of dynamite	3.16 tons
Dynamite used for secondary blasting (sticks 1 in. × 8 in.) (Extra D)	9,450 lb.
Stone blasted per lb. of dynamite (secondary)	29.78 tons
Dynamite used for both primary and secondary blasting	98,400 lb.
Stone blasted per lb. of dynamite	2.86 tons

The track along the working face and for a safe distance back along the line toward the crusher is removed before setting off primary blasts. The whole quarry force is employed in removing the tracks and replacing them later. The shovel loads the rails and the bundles of ties slung together with chain, onto the quarry cars, which are moved away to a safe distance. Following the blast and after the shovel has cleaned up the loose stone, the track is replaced.

Loading.—The steam shovel is a 100-B, full-circle, crawler-type Bucyrus with a 3-cu.yd. dipper. It loads the stone into 12-cu.yd. Western side-dump cars which are hauled by an 18-ton Vulcan steam locomotive to the primary crusher. The shovel crew consists of one operator, one fireman, and one pitman. The one shovel handles the quarry output of 1,000 to 1,500 tons per day. The steam shovel is being replaced by a Marion Type 4160 electric shovel, mounted on crawling traction trucks, equipped with 34-ft. steel boom, 21½-ft. dipper stick and 4-cu.yd. dipper, and operated by 2,300-v., 3-phase, 60-cycle alternating current. The steam shovel is to be transferred to another quarry of the

company, where the tonnage handled is somewhat less.

A shovel of the electric type was deemed desirable for several reasons, the principal ones being cheaper operation and the ease of bringing power to the shovel and keeping the shovel in repair. The electric shovel has a 4-cu.yd. dipper, as compared with a 3-cu.yd. dipper on the shovel it is replacing. Power will be brought to the shovel by a No. 4 four-conductor Rome super-service cable, 750 ft. long.

Upon arrival at the primary crusher, the loaded cars are dumped by means of a compressed-air cylinder, which hooks and lifts one side of the car, dumping the stone into the crusher. The layout of the crushing plant (not including grinding mills) is shown in Fig. 3.

Transportation.—The track in the quarry is laid directly on the quarry floor and is not ballasted. The men who do the secondary drilling and blasting also maintain the track. Little work is required for routine maintenance, probably only a few man-hours in a month.

Although the plan of the quarry (Fig. 2) shows the quarry track as a loop, the full loop is not used at present. The locomotive approaches the shovel with empties from the east and removes these cars to the east after they are loaded. After the removal of the four loaded cars from the shovel, the locomotive must take them to the crusher and pick up empties to serve the shovel, hence the shovel is idle for about 10 min. while waiting for the empties.

In present practice the locomotive is always on the crusher side of the loads at the shovel, but at the run-around switch at the crusher it shunts them by and getting on the shovel side of the loads,

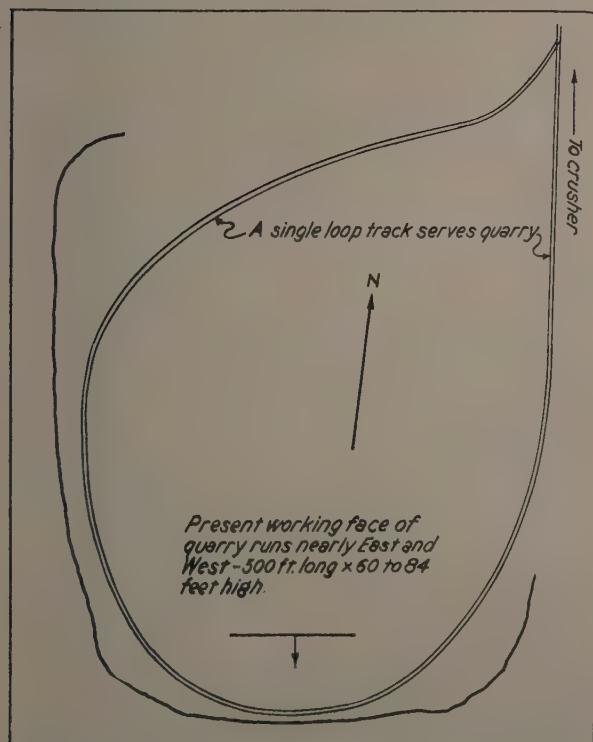


Fig. 2. Plan of the quarry and track.

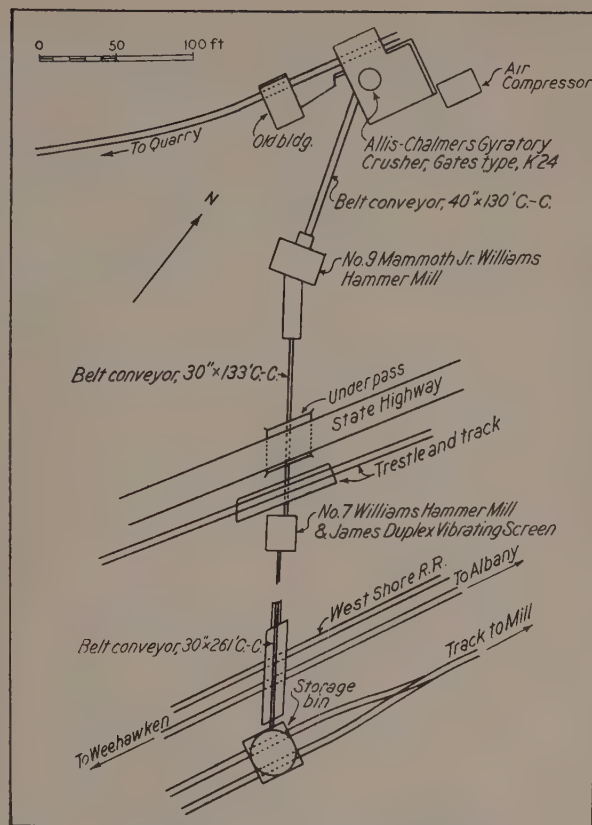


Fig. 3. Lay-out of the crushing plant.

pushes them beyond the crusher, and picks up a train of four empties. The locomotive is then between the loaded cars and the empties, and starting for the shovel with the empties on the shovel side, drops the loaded cars at the crusher where a car puller operated by compressed air places the cars for dumping.

The loop track will be placed in use within a few weeks. The locomotive will then handle trains in cars of three, approaching the shovel from opposite sides alternately, and pushing a train of loads away as it places a train of empties. In this way there will be no lost time at the shovel. Three trains of three cars each will be used, and while a train is in transit, there will be a train at the shovel and another at the crusher. This change in practice will involve no changes in track layout other than some grading on the storage track beyond the crusher, so that empties can be dropped down for the locomotive.

In moving the track serving the working face, the track is taken apart in sections about 150 ft. long, and the shovel lifts the track to its new position. It makes the first move of the track from its position on the quarry-face side of the track, then moves through the opening between the sections of track to the outside of the track. The work is completed from the outside, except that an opening large enough for the shovel to pass is left, and this is closed after the shovel is again between the track and face.

Crushing and Screening.—The 1,500 tons of stone (plus overburden) quarried per day passes successively through a gyratory crusher, a large hammer-mill, and small hammer-mill. About 150 tons of clay is added at this point and passes through the ball-mills and the tube-mills with the stone, each of the two ball-mills handling about half the total tonnage and each of the four tube-mills handling about one-quarter of it. There is no sizing during the process, except that a screen with $\frac{5}{8}$ -in. openings removes about one-third of the discharge of the large hammer-mill as undersize which by-passes the small hammer-mill. However, upon completion of the new screen equipment the stone-clay-water slurry will be screened at the ball-mills.

The machines used for crushing and grinding, with the approximate size of reduction and the rate of output for each, are listed in the accompanying table. The output figures for slurry are based on weights of dry material.

The output figures for the ball-mills and tube-mills are based on the mill hours operated and tons ground for the year 1930. The outputs per hour for these mills are not comparable to those for the gyratory crusher and hammer-mills for the reason that the grinding mills operate day and night, as needed to maintain stocks of ground material for the kilns, whereas the crusher and hammer-mills operate in the day only. The slack is taken up by the concrete stone storage bin after No. 7 hammer-mill, by the open storage served by a Whiting electric crane, and by the preliminator (ball-mill) feed bins. There is no storage between the ball-mills and the tube-mills, so the tube-mills must operate when the ball-mills operate. The operating ratio is usually two tube-mills to one ball-mill, but sometimes with one ball-mill running, three tube-mills

are run in order to maintain the fineness of hard grinding material. This will account for the slight discrepancy between the total of 61.6 tons per hour for the four tube-mills and the 63.8 tons for the two ball-mills.

The gyratory crusher is a Gates-type Model K-24 Allis-Chalmers and is driven through a belt by a 200-hp. induction motor. The larger hammer-mill is a No. 9 Williams Mammoth jr., and is driven at 870 r.p.m. by a direct-connected 500-hp. slip-ring motor.

The smaller hammer-mill is a No. 7 Williams New Type and is driven at 1,170 r.p.m. through a direct drive by a 200-hp. slip-ring motor. This mill is preceded by a 2-deck James Duplex vibrating screen, with screens 4 ft. wide and 7 ft. long. The upper deck is for heavy screening and scalping, and the lower deck for producing the finished product. The stone passing through the lower deck is about one-third of the total tonnage handled by the screen, so that the material retained on the screens and going from them to the hammer-mill is about two-thirds of the total tonnage. The stone leaving the small hammer-mill and that passing through the screen is carried away by a belt conveyor.

Grinding.—Operating data for the grinding mills during 1930 when 312,700 tons of slurry (not including weight of water) was ground was:

	Ball-mills	Tube-mills
Approximate ball load (lb.)	24,000	50,000
Diameter of balls (in.)	4	$\frac{7}{8}$
Total weight of balls, worn out (lb.)	319,305	
Total cost of balls	\$13,922	
Weight of balls worn out per ton of ore ground (lb.)	1,021	
Cost of balls per ton of ore ground	\$0.0445	
Cost of replaced liners	\$281.00	\$4,701.00
Cost of replaced liners per ton of ore ground	\$0.0009	\$0.0150

No ball consumption is shown for the ball-mills. There was an unknown quantity of old balls used, balls that were not carried on the stores card and which were thus not charged to the ball-mills when used. Hence there is no way of computing the consumption.

The cost figures represent the cost of the balls and liners only and do not include labor. Ten end-liner plates, and no side liners, were put in the ball-mills. Seventeen end-liner plates and two complete sets of liner plates were put in the tube-mills.

The two ball-mills are Allis-Chalmers preliminarators, 8 ft. in diameter by 7 ft. long. One mill has been equipped with a rotary screen, the oversize from which passes to an elevator to be returned to the mill. This screen will be removed, however, as two 8-ft., Type 42 Hummer vibrating screens are being installed to serve the two preliminarators. As mentioned before, clay and water are added to the stone as it enters the preliminarators, and the Hummer screens will handle this slurry. The slurry passing through the screens will go directly to the tube-mills, while the oversize will be returned to the preliminarators for further grinding.

MACHINES USED FOR CRUSHING AND GRINDING, SHOWING APPROXIMATE SIZE OF REDUCTION AND RATE OF OUTPUT FOR EACH

Machines	Size of Material		Output tons per machine per hr.
	Entering	Leaving	
1 No. 24 Gates-type gyratory crusher	4 ft. and under	8 in. and under	104
1 No. 9 Williams hammer-mill	8 in. and under	1½ in. and under	104
1 No. 7 Williams hammer-mill	1½ in. and under	¾ in. and under	70
2 Allis-Chalmers ball-mills, 8 ft. diam., 7 ft. long (preliminators)	¾ in. and under	94 per cent. passing 10-mesh sieve	31.9
4 Allis-Chalmers tube-mills, 7 ft. diam. by 16 and 20 ft. long	97 per cent. passing 10-mesh sieve	90 per cent. passing 200-mesh sieve	15.4
Per Cent. Passing:	No. 7 Hammer-mill Discharge = Ball-mill Feed		Ball-mill Discharge = Tube-mill Feed
200-mesh	11.1		51.0
100-mesh	12.5		55.8
80-mesh	14.2		57.4
60-mesh	16.4		59.4
50-mesh	20.1		62.2
40-mesh	24.2		66.4
30-mesh	41.2		71.2
20-mesh	47.0		79.4
10-mesh	63.5		93.8
6-mesh	88.5		100.0
4-mesh	100.0		100.0
¾-mesh			100.0
¼-mesh			100.0

¹ Approximate average output in 1930; figures do not represent capacity of machines, but average output.

² Estimated average output; about one-third the material by-passes this mill through the screen.

³ Average output in 1930.

NOTE: The gyratory crusher and the two hammer-mills crush stone (plus overburden); the two ball-mills and four tube-mills grind slurry (stone-clay-water). The output figures for these grinding mills are based on weights of stone and clay without water; the proportion of stone to clay is about 9 to 1.

The four tube-mills are of Allis-Chalmers make, 7 ft. in diameter; two are 16 ft. long and two are 20 ft. long. Each tube-mill is driven at 21.8 r.p.m. through a countershaft, pinion and gear, by a 300-hp. induction motor.

As stated grinding of the stone with clay is done to reduce and mix the materials preparatory to burning to cement clinker. Although no grading for sizes is done, close control of the fineness of the slurry leaving the tube-mills is effected by means of sieve tests made at hourly intervals. Coarse particles are detrimental to easy and complete combination of the components during burning. The fineness of the slurry leaving the tube-mills is regulated by controlling the rate of their feed. The fineness of the slurry is kept at or above 90 per cent. passing a 200-mesh sieve.

The chemical composition of the raw material is kept under strict control. Samples of the slurry leaving the tube-mills are analyzed hourly for their calcium-carbonate content. Chemical control of materials extends from the quarry through the various plant departments, but it is not necessary to describe it here. The proper composition of the raw materials is attained by the following controls:

Quarrying stone that is suited for the cement mixture.

Blending of crushed stone in the open storage.

Use of proper amounts of clay, varying the quantity to suit composition requirements.

Blending of slurry in tanks by mechanical and air agitation.

The material-handling equipment and practice are summarized as follows:

From	Means of transportation	To
Quarry face	One 18-ton Vulcan steam locomotive, 4-wheel, saddle-tank, hauls quarried stone about $\frac{1}{2}$ mile in 12-cu.yd. Western side-dump cars in trains of four cars over standard-gage track; rails, 60 lb. per cu.yd.; maximum grade, about 1 per cent.	Gyratory crusher.
Gyratory crusher	One belt conveyor, with belt 40 in. wide and 130 ft. between centers, conveys crushed stone	No. 9 hammer-mill.
No. 9 hammer-mill	One belt conveyor, with belt 30 in. wide and 133 ft. between centers, conveys crushed stone	No. 7 hammer-mill.
No. 7 hammer-mill	One belt conveyor, with belt 30 in. wide and 261 ft. between centers, conveys crushed stone	Concrete stone storage bin.
Concrete stone storage bin	One 40-ton Porter steam locomotive, 4-wheel, saddle-tank, hauls crushed stone about 4,000 ft. in 40-ton steel hopper cars in trains of two cars over standard-gage track; rails, 67 and 80 lb. per cu.yd.; maximum grade, about 2 per cent.	Open storage.

Open storage

One 3-cu.yd. Whiting electric crane, span 80 ft., powered by four motors, handles stone in storage and reclaims it from storage (this crane also serves cement-clinker and coal storages). It delivers to one 24-in. by 153-ft. belt conveyor, which in turn delivers to the 20-in. by 220-ft. belt conveyor that delivers to the ball-mill feed bins

Ball-mills (preliminators).

Clay quarry

One 40-ton Porter steam locomotive (used also for hauling stone) hauls clay about 1,500 ft. in 6-cu.yd. Western side-dump cars in trains of three cars over standard-gage track; rails 67 and 80 lb. per cu.yd.; maximum grade about 2 per cent.

American clay machine.

Note: Water is added to clay in the clay machine and the clay in suspension is pumped to storage tanks by a centrifugal pump. It runs by gravity, as needed, to the two ball-mills, where it meets the stone and where more water is added. The slurry consists of about 57 per cent. of stone, 5 per cent. of clay, and 38 per cent. of water.

Ball mills (preliminators)

Two Link-Belt chain-and-bucket elevators, with 8 by 8 by 16 in. buckets, receive the slurry (stone-clay-water) from the trough leading from the two ball-mills, and deliver it to a 40-ft. Smidth horizontal mechanical agitator which feeds it to the four tube-mills

Tube-mills.

The electric power used by the motors is 3-phase, 60-cycle, 440-v. alternating current. The air compressor serving the quarry is a 750 cu.ft. Chicago Pneumatic Tool Co. machine driven by a 130-hp. synchronous motor.

Clay-quarrying operations are simple, and a few words will suffice to describe them. Clay is used as a source of silica, iron, and alumina for the cement mix. The clay is soft and plastic with no sandy material and but little loam. One $\frac{3}{4}$ -cu.yd. full-revolving, crawler-type Osgood steam shovel is used. The dipper noses into the clay bank and tears out the material which it loads into 6-cu.yd. Western side-dump cars. The clay is hauled by steam locomotive to the 10-ft. American clay machine, where water is added and the clay broken. The suspended clay is pumped to storage tanks, whence it runs by gravity to the preliminators, as needed.

Safety and First-Aid Work.—In discussing the subject of safety and first-aid work it is difficult to separate safety activities in the quarry from those of the plant as a whole, but the following state-

ments are applicable to the quarry in that it is one department of the cement plant.

There is a plant safety committee, made up of all plant department heads, which meets monthly to discuss safety and first-aid matters. There is another group known as Distinguished Safety Workers Club, made up of 12 workmen who have shown outstanding interest in safety work. This group meets monthly and is presided over by the chairman of the plant safety committee. Each second Saturday a departmental safety meeting is held, at which a workman gives a talk on safety and dangerous and unsafe practices are discussed and suggestions made for their elimination. A good-house-keeping campaign, with regular inspections, is carried on in all plant departments.

Some time ago a first-aid instructor from the U. S. Bureau of Mines visited the plant and trained selected men in first aid, and the bureau first-aid methods are used at the quarry and throughout the plant. The men first trained in this work have in turn acted as instructors for other men of the plant organization, until now 40 of the 150 men employed at the plant have had first-aid training. There are two first-aid teams in the plant, made up of the men most proficient in this work, and it is planned to have these teams compete.

Organization and Wages.—A list of men employed at the quarry will suffice to indicate the quarry organization and includes the following:

1 quarry foreman	1 jackhammer driller
3 well drillers	1 hammer-mill operator
1 shovel operator	(for 2 mills)
1 shovel fireman	1 conveyor-belt operator
1 shovel pitman	1 blacksmith
1 blaster	1 blacksmith's helper
1 locomotive engineer	2 car repairmen
1 gyratory-crusher operator	1 night watchman

The total quarry force, including employees of the crushing department but not those of the grinding department or clay quarry, is 18 men. The foreman is paid a monthly salary and the workmen are paid on an hour basis, their rates of pay varying from 40 c. to 73 c., with an average of 53 c. an hour. There is no contract or bonus system used. The quarry normally is operated 10½ hours a day, in daylight only, and about 270 days a year. The quarry is usually closed on Sunday and there is a shutdown of some weeks during the winter.

Costs.—The costs of quarrying stone, crushing stone, quarrying clay, and grinding stone plus clay given here are based on operations for the full year 1930. The cost of quarrying 281,400 tons of dry stone was as follows:

	<i>Per ton</i>
All labor	\$0.0988
Supplies other than power, fuel, and explosives	.0394
Electric power	.0061
Coal (shovel and locomotive)	.0166
Explosives	.0499
Stripping	0
Total cost	\$0.2108

The cost of crushing 281,400 tons of dry stone before the addition of clay in the gyratory crusher and two hammer-mills was as follows:

	<i>Per ton</i>
All labor	\$0.0371
Supplies other than power and fuel	.0436
Electric power	.0178
Coal for locomotive hauling	.0047

Total cost

The cost of quarrying 31,300 tons of clay:

	<i>Per ton</i>
All labor	\$0.0835
Supplies other than power and coal	.0118
Coal for shovel and locomotive	.0178

Total cost

The cost of grinding slurry (stone plus clay), a total of 312,700 tons of material being ground, was:

	<i>Per ton</i>
All labor	\$0.0613
Supplies other than power	.0797
Electric power	.1398

Total cost

Man-hours per unit of production, stone, 281,400 tons, and clay, 31,300 tons, was:

Quarry: Man-hours per ton of stone quarried	0.169
Crushing: Man-hours per ton of stone crushed	.073
Clay: Man-hours per ton of clay quarried ..	.168

Canadian National Railways Urges Farmers Use Limestone

Practical results from the operation by the Canadian National Railways and the Provincial government of soil-improvement trains in the rural communities of Quebec are shown in a survey which has just been completed by the agricultural department of the railway. Since 1928 emphasis on the importance of improving the physical condition of Quebec soils, particularly through the use of domestic agricultural limestone, has been laid by the experts in charge of the trains. As a practical demonstration to the farmers no less than 12,000 separate samples of Quebec farm soils were tested and of these over 70 per cent. were shown to be suffering from excess acidity.

Use of Quebec crushed limestone to correct this condition has been strongly recommended with the result that the amount of this commodity moved over the railways for the use of farmers showed an increase of 400 per cent. between 1928 and 1930. In 1928 only 4,628 tons of limestone were moved for this purpose in the province of Quebec. Last year the figure was in excess of 25,000 tons.

Through the efforts of the Canadian National Railways' department of agriculture, limestone intended for soil improvement in the province is now moved over the railway from points in Quebec at special rates and the cost of limestone to the farmer at the quarries has been further reduced. All supplies under the present scheme come from various quarries in the province of Quebec, the principal ones being those at St. Mark, Hull and Joliette.

Advantages of a Uniform Sales Contract to Crushed-Stone Producers*

By JOHN RICE, Jr.
General Crushed Stone Co.

With Remarks by ELLWOOD GILBERT
Sales Manager, New Castle Lime & Stone Co.

IT might not be amiss to discuss at this time the laxness with which crushed-stone producers have handled their sales. Too many of them in the past have not used contracts. It is true that many have had order forms on which sales were registered, but in most cases the buyer was not even required to sign these forms. Many contracts which have been used, and which are still in use by certain producers, contain terms that would not be legally accepted and afford neither themselves nor the buyers adequate protection. Verbal orders, involving thousands of tons of stone, have been accepted by crushed-stone producers who trusted entirely to luck that the buyer would be successful in his work. Many producers do not fully appreciate the laxness with which they are carrying on their sales. No large or well-known concern to-day would countenance the careless basis on which orders for stone are accepted by crushed-stone producers.

It is evident, therefore, that there is an urgent need for producers to get together and adopt a proper form of uniform sales contract in the handling of their sales. The question may arise as to what is a good uniform sales contract and in reply I would answer that it is one that is agreeable to all the producers in a particular locality, legal in respect to existing statutes, fair in respect to its demands on the buyer, and sincere in its guarantee to perform satisfactory service and supply material that will adequately meet specifications. It cannot be one-sided, for it must afford adequate protection to both the buyer and seller in order to be successful.

It is necessary, of course, to have the contract not only written in the proper legal form, but to have its terms legally acceptable. I shall describe briefly a form which was recently adopted by the Pennsylvania Stone-Producers' Assn. and the New York Crushed-Stone Assn. There is a space at the top of the form reserved for the name and description of the seller and the purchaser. There is also a space for the name of the project, the sizes of stone that will be used, the quantity, price, and delivery. There is a place where the freight or trucking rate can be noted and, in connection with the rate, it states that delivered prices are quoted only for the convenience of the purchaser. The purchaser is liable for any increase in the rate or tax thereon and shall benefit by any reduction.

Next comes a place for the terms of payment, and it is not only important, but vital, that each local association or group of producers agree to spe-

cific terms of payment. Following this comes another clause stating that if at any time the financial responsibility of the purchaser becomes impaired or unsatisfactory to the seller, the seller reserves the right to exact payments in advance or a satisfactory security or guarantee that invoices will be paid promptly when due. If the purchaser fails to comply with the terms of payment, or with any other provisions of the agreement, the seller reserves the right to cancel the unfilled portion of the contract, the purchaser remaining liable for all unpaid material furnished and for all damages incident to the purchaser's default.

The following clause is for the buyer's protection and is responsible for making the contract attractive to the purchaser, as it protects his interest in the project. The clause is headed, "Time of Delivery," and it states: "Material to be furnished during the period beginning and ending 193.. Shipments to be made at the rate of approximately tons per day, but not to exceed tons per day. The purchaser shall give the seller shipping instructions a reasonable time before shipments are to be made or modified. The seller shall not be responsible for delays caused by strikes, accidents, car shortage, or other contingencies not under the seller's control, nor for any delays in transportation. If the purchaser fails to order all the material to be shipped within the time provided, then the seller reserves the right to extend the time of delivery, but shall not be obliged, except at the seller's option, to furnish any part of said material after 193.."

The terms under "Time of Delivery" are many and there are few producers who have not, at some time or other, been affected because of failing to protect themselves on several of these terms. Following this comes the heading "Specifications."

After this comes "Claims," under which appears the following: "The sellers' responsibility for the loading of cars ceases with the proper time of delivery to the carrier. Railroad weights and rules are to govern all railroad shipments. Standard scale weights are to govern all other deliveries. The seller will not honor claims for material for a failure to comply with the standard of quality, nor allow credit for the rejection of material, unless notified by telegram immediately after the rejection and before unloading, all such claims being subject to inspection of the material in the car by an authorized representative of the seller."

The year prior to our company's using this form of contract, we had several lawsuits regarding weights of stone delivered by both railroad and

*Presented at the 1932 Convention, National Crushed Stone Assn., Pittsburgh, Pa.

truck. Since using this form we have had a number of claims regarding shortage in weights by both railway and truck delivery, and in each case we referred to the contract that had been signed, in which the purchaser agreed not to question these weights, and in every case we have had a prompt settlement of the account in question.

Following "Claims" comes the assignment clause, stating that the purchaser shall have no right to assign this contract without the written consent of the seller. "The material covered by it is sold to the purchaser upon the representation that it is purchased for use in the construction of work in connection with the project above referred to. The use of material covered by this contract in any work other than indicated herein, or the disposition of it for any other purpose, shall give the seller the option to terminate this contract, and such termination shall not prejudice any claims of the seller for the value of the material furnished or for damages."

Following this comes the date on which the contract is executed, the name of the seller's company, the signature of an officer of the company, and the name of the buyer's company, and the signature of an authorized agent or officer of his company.

It is very important that a uniform sales contract be not too large in size, nor contain too many terms; otherwise, it may arouse the buyer's suspicion and cause him to think that hidden somewhere in the contract there is some clause that might be tricky or burdensome to him. There are naturally a number of different forms of sales contracts that are both protective and acceptable. Uniform sales contracts must in some cases differ because of different statutes existing in different territories. Uniform sales contracts, therefore, should be drawn for each particular territory or district where the existing laws are the same. There are also many uniform contracts that contain a great many more terms than the one to which I have referred. As far as size and length are concerned, I believe that the one of which I have made mention is adequate in these respects.

Now the advantages of the uniform sales contract are:

1. All buyers in a particular territory are subject to identical terms of sale. This eliminates buyers' quibbling about terms of payment, discounts and rebates, and other unfair demands. After the buyer becomes accustomed to using the uniform sales contract, he considers this a standard or a guide and insists that other contracts cover the same terms as the uniform contract in use in his territory.

2. The uniform sales contract aids in stabilizing prices for stone in a particular locality, since the terms in the contract have been agreed to by the producers in the locality. Often the existing prices are sooner or later upset, because a few producers continue either to extend the terms for payment or to offer excessive discounts for cash or prompt payment. This is merely a form of price-cutting, which eventually destroys the price structure in any market.

3. A uniform sales contract is unquestionably better drawn and better constructed from the standpoint of protection than would be the case if the drawing of the agreement were left to the experience of an individual firm, as it consolidates the experiences of all the operators in a particular district. An individual firm may fail to protect itself on several terms, which is not so likely to be the case if it is drawn by a group of firms.

4. A uniform sales contract forces the buyer to cover his purchases by a contract, since all buyers in a particular locality are requested by all producers to sign it. The buyers soon become reconciled to the situation and eventually like the idea of having all the conditions and terms of sale written out in a clear-cut fashion. The reason many stone producers at present hesitate to use any form of contract is because of the buyer's resistance to signing it. It is naturally his preference to do business with a producer that will be lenient in the terms of sale.

Unless an operator is willing to have his business conducted along careless and reckless lines, he should further investigate the uniform sales contracts now in use. He should assemble his competitors and join with them in agreeing to some uniform contract. No business can be properly conducted unless its sales are adequately protected.

Remarks by ELLWOOD GILBERT <i>Sales Manager, New Castle Lime & Stone Co.</i>

During the ten or twelve years preceding 1930, the State of Pennsylvania consumed millions of tons of crushed stone in the construction of its primary- and secondary-highway systems. As this work was done almost entirely by contract, it was necessary that the sale of our commodity be made direct to the contractor. There were as many different sale-contract forms as there were producers, each one using a form which he thought best suited his purpose, but no one giving heed to the thing most vital to us all; namely, whether our interests were protected in case of the failure of the contractor. Unfortunately, in some cases we were not, with the result that many thousands of dollars were lost to the manufacturers of crushed stone. After many of us had tasted this bitter experience, the necessity of having a uniform sales contract was greatly emphasized.

During the time in which I have been identified with the crushed-stone industry, my efforts have been expended in the field of sales promotion and, naturally, any advantage reflecting on the producer would be viewed by myself from a salesman's point of view.

The first advantage suggested by Mr. Rice is that all buyers in a particular territory will be subject to the identical terms of sale. This I believe to be very important and, if the terms of sale are adhered to consistently, will rather quickly tend to eliminate from the field of prospective buyers the financially irresponsible and unqualified contractor.

The modern method employed in marketing finished products has done much to increase the

crushed-stone producers' risks. It is entirely possible for anyone possessed of very limited capital, and much less knowledge of the contracting business, to equip himself with tools and machinery sufficient for carrying on a contract where several hundred thousand dollars may be involved. However, if persons such as these are compelled to purchase their materials on a uniform-sales-contract basis and if the terms of payment are strictly adhered to, he will be placed at a big disadvantage as compared to the responsible contractor with sufficient credit to borrow the money necessary to discount his bills. With the uncompromising terms of a uniform material-sales contract facing both the reliable and the unreliable contractor as he sits down to estimate a project, it will certainly cause the one with uncertain credit standing to hesitate before using a discounted price on his material estimate, thus forfeiting a big advantage to his competitor who is in a position to meet his obligations on time. Thus, he indirectly places in our hands a prospect on whom we take little risk.

Another advantage of a uniform sales contract is that the terms are the same for all buyers in a particular locality, and that this tends to stabilize prices. The truth of this statement can be shown through price conditions as they exist in our state. After using a uniform sales contract less than one year, the price of crushed stone has become stabilized. Our state is made up of three geographical groupings, in each of which the operating conditions are different; hence, selling prices must differ. However, in each of the three groups we find that there is a well-recognized market price, and wide deviations from this price are so rare that we are justified in our statement when we say that 90 per cent. of the commercial crushed stone sold in our state is sold at a uniform price, based on the district in which the sale and delivery are made.

Another advantage is that the producer who is working under a uniform sales contract, that has been drawn up and accepted by a group of producers, has the advantage of having incorporated in his contract a more complete coverage, since it is the result of the experience of many different men. The truth and force of this statement are too self-evident to need additional emphasis.

The fourth and concluding advantage to which Mr. Rice has drawn attention is that, even though the producer may hesitate to adopt a form of sales contract on account of the sales resistance it may set up, he finds, after it has become generally used and its provisions are familiar to both himself and the buyers, that both parties welcome it as an instrument on which to lean for service and protection.

I should like to be permitted to draw the inference from this concluding statement that a uniform sales contract establishes a common ground upon which sales representative meets the potential buyer. Under these conditions, confidence and respect are established in the mind of the buyer; and the salesman is possessed of new-born courage, mainly so because he knows that the material, service, terms, and price are being offered to the buyer

under the same conditions as the buyer may hope to receive from the salesman's competitor. Often it happens, where a sales contract is not being used, that there is doubt in the salesman's mind as to just what is being offered the buyer in return for his business. Repeat sales to a friendly consumer are lost with the argument ringing in the salesman's ears that better terms and prices are being offered. Often, after repeated calls on a customer, our confidence in our competitor is broken, even though unjustly, and the business is taken at a big disadvantage to ourselves. Distrust has been established in the mind of our competitor and future sales on a profitable basis become even harder to secure.

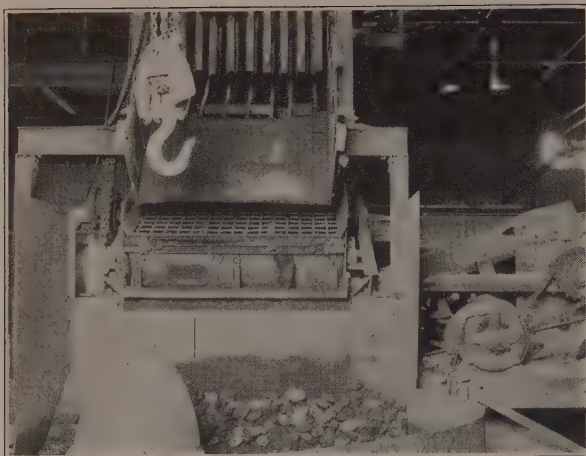
From the viewpoint of a salesman, I like to be mindful always of this fact when approaching a prospective buyer: that the true measure of a man can not be had by approaching him from the front, but rather must we get back of him and stand in his tracks, and looking through his eyes, get the same perspective. I am firmly convinced that the use of a uniform sales contract by any group of producers makes it possible for the buyer and the salesman to stand shoulder to shoulder on common ground and, each looking in the same direction, through the same eyes, get but one perspective, and, with this mutual understanding and confidence established between them, they both are benefited and go forward to better things and greater opportunities.

Slate Sales Decline 24 Per Cent.; Dollar Volume Drops More

The slate sold at the quarries of the United States in 1931 was approximately 351,400 short tons, valued at \$5,361,000, according to estimates furnished by producers to the United States Bureau of Mines. This was a decrease of 24 per cent. in quantity and 32 per cent. in value from the output reported for 1930—463,610 short tons valued at \$7,911,618.

The roofing slate sold in 1931, estimated at 265,000 squares and valued at \$2,293,000, decreased 22 per cent. in quantity and 32 per cent. in value from 1930. The drop in value represents a decrease of \$1.25 in the average value per square. The decrease in quantity was largest in the New York-Vermont district where the estimated sales in 1931 amounted to 62,160 squares valued at \$793,000, a decrease of 45 per cent. in quantity and 47 per cent. in value in comparison with the preceding year. The sales of roofing slate in Pennsylvania were estimated at 180,340 squares valued at \$1,256,052, a decrease of 7 per cent. in quantity and of 15 per cent. in value.

The total sales of mill stock in 1931, estimated at 5,689,400 sq. ft. valued at \$1,720,000, decreased 28 per cent. in quantity and 38 per cent. in value in comparison with 1930. Mill stock for structural slate, 1,820,000 sq. ft. valued at \$630,000, decreased 27 per cent. in quantity and 34 per cent. in value. Electrical slate, 479,000 sq. ft. valued at \$330,000, decreased 48 per cent. in quantity and 54 per cent. in value. Slate for school slates, 1,485,000 pieces (794,200 sq. ft.) valued at \$17,000, decreased 12 per cent. in both quantity and value.



Grizzly and scalping screen which feed the material to the primary crusher below.



Elevator leading from the scalping and crushing units to the top of the screening plant.

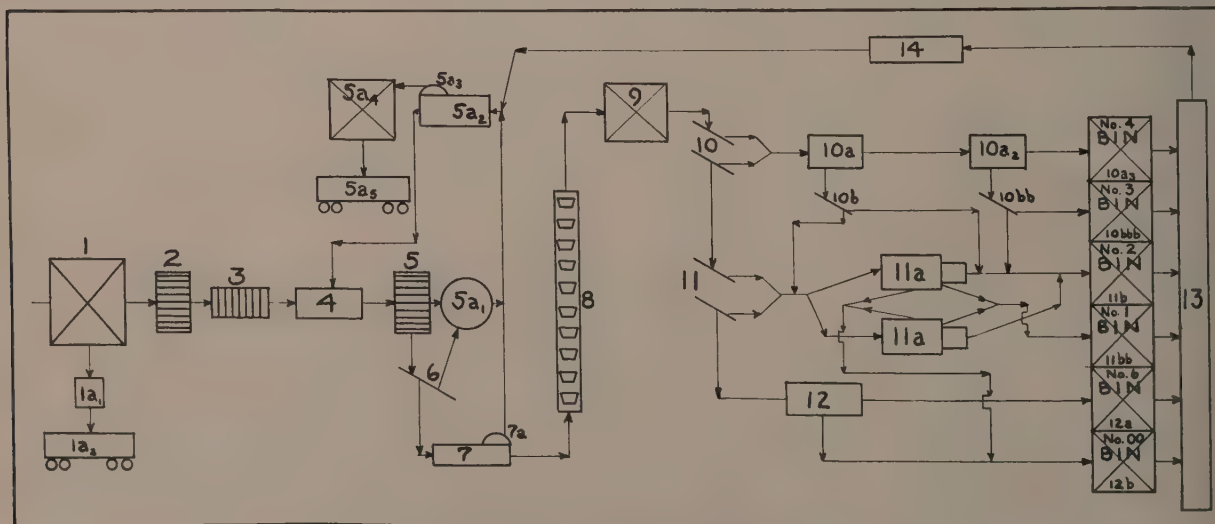
New Slag-Crushing Plant Has Output of 43 to 45 Tons per Man-Hour

Lackawanna, N. Y. Operation of Buffalo Slag Co. Enjoys Low Production Costs

ONE of the most recent new plants to be built in the slag industry and one of the largest now in existence is that of the Buffalo Slag Co., at Lackawanna, a suburb of Buffalo, N. Y. This plant is also one of the most efficient in the industry. At full capacity it will produce $7\frac{1}{2}$ carloads of sized slag per hour or 4,000 tons in a 10-hr. day with only 9 men. Ordinarily, a capacity of about 300 tons per hr. is obtained with only 7 men. Features of this plant are its flexibility of design and operation, its permanent, fireproof steel-and-concrete construction, and the unusual precautions taken to remove all iron and dust from the finished product. This new plant was not built to increase

the company's productive capacity, but to provide a better product at a lower cost. The company now operates 8 slag plants in western New York and northwestern Pennsylvania.

The Buffalo Slag Co. began its operations in this field 19 yr. ago with a plant at the foot of Catherine St., in Buffalo, N. Y. This has been operated almost continuously since that time but is closed because of the abandonment of the furnaces which supplied it with slag. The company's second plant was operated steadily until Jan. 10, 1931. It was then shut down and some of the equipment moved to the new No. 2 plant which replaced it and which went into operation late in February, 1931. The old building



Flow-sheet of the new Lackawanna plant.

was left standing and is now being used by a producer of pre-mixed concrete.

The new plant is at the foot of Steelawanna Ave., in Lackawanna about 5 mi. from down-town Buffalo.

The slag used in this plant comes from the furnaces of the Bethlehem Steel Co., the Hanna Furnace Co. and the Republic Steel Corp. The slag company operates a Model 70 Marion, 2½-cu.yd. crawler steam-shovel for loading the Bethlehem Steel Co. slag directly into railroad cars about 3 mi. south of the plant. These cars are hauled to the plant by the South Buffalo Railway Co. The slag obtained from the Hanna Furnace plant, which is adjacent to the slag plant, is loaded by two Model 37 Marion electric-shovels and is switched to the slag plant over a private track by a 65-ton American steam-locomotive. The Republic Steel Corp. loads the slag from its furnaces with a Marion 37 electric shovel and ships via the South Buffalo Railway Co. to the slag plant. Slag is obtained at both sources as it cools but a dump at the Bethlehem furnaces contains about 1,000,000 cu.yd. of slag which is used when the furnaces are shut down or unable to supply sufficient slag for the plant.

At the plant the cars of slag are run on an elevated track with a concrete-walled fill. They discharge into a 200-ton capacity track hopper with an 18-in. rail grizzly. The material retained on the grizzly is usually iron and is removed by a Shepard 7-ton overhead electric hoist, running on



New plant of the Buffalo Slag Co.

an overhead rail, to railroad cars on a special siding for shipment back to the furnaces. These large pieces range from 500 lb. to 2 or 3 tons in weight.

The material passing through the grizzly is fed to a 40-in. Stearns apron-conveyor operating on 30-ft. centers in a concrete pit alongside the track hopper. This is inclined except for a short distance at the receiving end and discharges to a 48-in. inclined belt-conveyor, which operates on 140-ft. 6-in. centers and discharges over a 7-in. sloping-bar grizzly. The material passing through this grizzly goes to a Niagara 4-ft. by 8-ft. single-deck vibrating scalping screen fitted with 4-in. Rolman manganese-wire cloth. The "oversize" from both the grizzly and the screen drops to an Allis-

TABULAR ANALYSIS OF THE OPERATION AND EQUIPMENT OF THE BUFFALO SLAG CO., PLANT NO. 2, LACKAWANNA, N. Y.

(Key numbers refer to the equipment shown on the accompanying flow-sheet.)

Operation	Key	Equipment	Make	Model No., Size, Capacity, or Type	Power Source	Power Transmission
Raw-material handling	1	Shovel Shovels (2) Locomotive Cars Hopper	Marion Marion American	Model 70, 2½ cu.yd. 1½ cu.yd. 65-ton 200-ton	Steam Electricity Steam	
Scalping and crushing	2 3 4 5 5a ₁ 5a ₂ 5a ₃	Grizzly Apron conveyor Belt-conveyor Grizzly Crusher Belt-conveyor Magnetic pulley (See Iron recovery, 5a ₂)	Stearns Stearns Allis-Chalmers Stearns Dings	18-in., rail 40-in. by 30-ft. 48-in. by 140-ft. 6-in. 7-in., rail No. 8 Gates 30-in. by 110-ft.	15-hp. Allis-Chalmers 5-hp. 75-hp. 7-hp. Direct-current	Falk reducer Falk reducer and chain Belt Falk reducer
	6 7 8 9	Vibrating screen Belt-conveyor Bucket-elevator Hopper	Niagara Link-Belt	4-ft. by 8-ft., 1-deck 48-in. by 16-ft. 36-in. by 100-ft.	5-hp. 10-hp. Westinghouse 100-hp. Allis-Chalmers	Dayton Cog-Belt Falk reducer and chain Falk reducer and Link-Belt silent chain
Screening	10 10a ₁ 10a ₂	Vibrating screen (Throughs to 11; oversize to 10a ₁) Revolving screen (Oversize to 10b) Revolving screen (To Storage, 10a ₂)	Niagara Allis-Chalmers Allis-Chalmers	8-ft. by 10-ft. 72-in. by 24-ft. 60-in. by 24-ft.	5-hp. Westinghouse 50-hp. Allis-Chalmers 25-hp. Continental Electric Co.	Dayton Cog-Belt Jones worm-gear reducer Jones reducer and chain
	10b 10bb 11 11a 12	Vibrating screen Vibrating screen (To Storage, 10bbb) Vibrating screen Revolving screens (2) (To Storage, 11b, 11bb) Revolving screen	Niagara Niagara Robins Allis-Chalmers Allis-Chalmers	6-ft. by 8-ft. 6-ft. by 8-ft. 5-ft. by 10-ft. 48-in. by 24-ft. 48-in. by 24-ft.	5-hp. General Electric 5-hp. General Electric 5-hp. Westinghouse 100-hp. Allis-Chalmers 50-hp. Allis-Chalmers	Dayton Cog-Belt Dayton Cog-Belt Dayton Cog-Belt Belt Belt
Storage	12a 12b 10a ₁ 10bbb 11b 11bb	Bin No. (00) Bin (No. 6) Bin (No. 4) Bin (No. 3) Bin (No. 2) Bin (No. 1)		125-ton 125-ton 125-ton 125-ton 125-ton 125-ton		
Reclaiming from storage	13 14	Belt-conveyor Belt-conveyor (To Scalping and crushing, 5a ₂)	Stearns Stearns	28-in. by 65-ft. 20-in. by 38-ft.	5-hp. General Electric 5-hp. General Electric	Falk reducer and chain Falk reducer and chain
Iron recovery	1a ₁ 1a ₂ 5a ₁ 5a ₂ 7a	Hoist Cars Hopper Cars Magnetic pulley	Shepard Dings	7-ton 24-in. diameter	Electricity Direct-current	



Hoist handling chunks of iron from grizzly to car for shipment back to blast-furnaces.

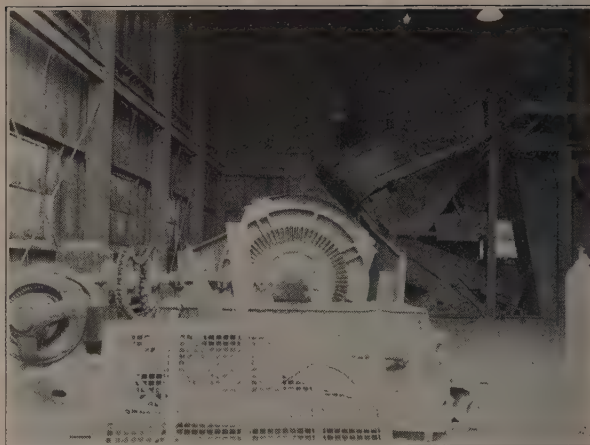
Chalmers No. 8 Gates gyratory crusher, which discharges to a 30-in. belt-conveyor that operates on 110-ft. centers and is fitted with a Dings 30-in.-diameter magnetic head-pulley. This separates the iron, which is chuted to a hopper from which it is loaded into railroad cars on a siding running into the plant. The slag is discharged back to the first belt-conveyor. The material passing through the scalping screen drops to a 48-in. belt-conveyor, which operates on 16-ft. centers and has a Dings 24-in.-diameter magnetic head-pulley. The iron separated here drops to the belt-conveyor which receives the crushed slag and feeds the iron directly to a hopper and cars on the track previously mentioned.

The slag from this last separation is discharged to a 36-in. belt-bucket elevator which operates on 100-ft. centers and feeds to the top of the screening building where it discharges into a hopper. From this the material passes to a Niagara 8-ft. by 10-ft. double-deck vibrating screen fitted with Rol-man 2-in. manganese-wire cloth on the top deck and 1½-in. cloth on the bottom deck. The material retained on both decks is chuted to an Allis-Chalmers 72-in. by 24-ft. rotary screen provided with 1½-in. Rol-man wire cloth.

The material passing through the bottom deck



Car-loading chutes beneath bins showing screens which divert fines to return belt-conveyor.



Revolving screen with two of the vibrating screens used in the plant in background.

of this vibrating screen goes to a Robins Gyrex 5-ft. by 10-ft. vibrator fitted with 1¼-in. and ½-in. wire cloth on the top and bottom decks respectively. The material retained on both decks goes through a split chute to two 48-in. by 24-ft. Allis-Chalmers rotary screens. The material through the bottom deck of the second vibrator goes to a 48-in. by 24-ft. rotary screen fitted with ¼-in. wire cloth. The slag over ¼ in. in size goes to a bin as No. 6, or roofing, slag. That passing the ¼-in. cloth goes to another bin as No. 00 slag, or "screenings."

The slag passing through the 72-in. rotary screen drops to a Niagara 6-ft. by 8-ft. single-deck vibrating screen fitted with ⅝-in. wire cloth. The "over-size" goes to a bin as No. 2 slag, while the mate-



One pair of the revolving screens.

rial passing through this deck is chuted to the two 48-in. rotary screens previously mentioned. The "tailings" from the 72-in. screen go to a 60-in. by 24-ft. rotary screen provided with 2¾-in. perforations. "Tailings" from this screen go to a bin as No. 4 slag. That passing through the 2¾-in. openings goes to a 6-ft. by 8-ft. Niagara single-deck vibrating screen fitted with 1½-in. wire cloth. The two sizes produced by this unit go to storage as No. 2 and No. 3 slag.

The two 48-in. by 24-ft. rotary screens previ-

ously mentioned have $\frac{5}{8}$ -in. Rol-man wire on their main barrels and $\frac{1}{4}$ -in. plain wire on their 16-ft. outer jackets. The material retained on the main barrels goes to the No. 2 bin, that retained on the outer jacket goes to the No. 1 bin, and that passing the outer jacket goes to the "screenings" bin.

The 6 steel bins supporting the screening building are somewhat unusual in design. They consist of a row of car-loading bins over two tracks and a row of smaller bins which are alongside these and have their bottoms at a lower elevation, the separating partitions between the two rows having been removed. Each of these combination car- and truck-loading bins has a capacity of 125 tons. Trucks are backed up alongside the bins and loaded through bottom-discharge clam-shell gates and sloping chutes. These gates are lever-controlled from a steel walkway under the bins.

The car-loading system has provisions for removing any breakage due to storage. Each bin



Truck being loaded at bin chutes.

has two bottom-discharge clamshell gates feeding inclined stationary screens, which have screen cloth with different size openings for the various sizes of slag. The cleaned slag is discharged directly into cars. The material passing through these screens goes to a 20-in. belt-conveyor that operates on 65-ft. centers horizontally under the bins. This discharges to a 20-in. horizontal belt-conveyor which operates on 38-ft. centers at right angles to it and feeds back into the plant to the conveyor leading from the crusher. The car-loading gates are controlled from another steel walkway under this section of the bins.

When the demand for slag is less than the plant's capacity and certain sizes become overstocked, they are loaded from the bins into a train of five 30-cu. yd. Western air-dump cars. A 50-ton American saddle-tank steam-locomotive hauls these cars to stock-piles, where they are dumped and the slag rehandled by two Ohio steam locomotive-cranes equipped with $1\frac{1}{2}$ -cu. yd. Hayward clam-shell buckets. A Marion 450 gas-electric crawler shovel is also used for this purpose. Two other 50-ton locomotives are used for general-utility purposes and for "spotting" cars of raw slag at the plant hopper. There is track storage for 50 cars of raw



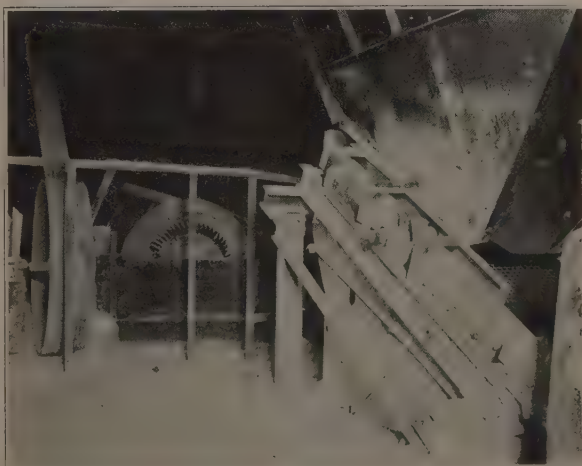
Drive of the pan-conveyor feeding from track hopper.

slag near the plant and two storage tracks in the yards will hold 50 loaded cars and 60 empty cars, respectively.

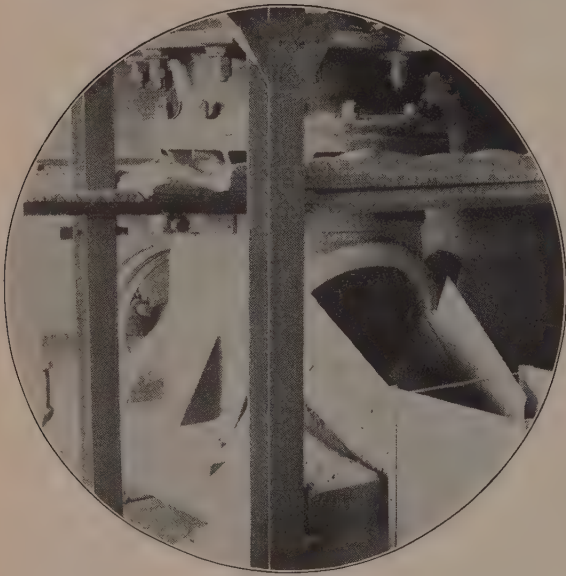
Electricity is purchased at 2,200 v. from public-service companies. Six Allis-Chalmers outdoor-type transformers in a neat brick transformer-house near the plant reduce this to 440-v., single-phase, 25-cycle current for all plant motors. Two smaller transformers reduce the current to 220 v. and 110 v. for electric heaters and lights. An instrument panel with switches, a Westinghouse wattmeter, and a recording voltmeter are also housed in this building.

A concrete-block inclosed switch-room in the main plant building has a switchboard controlling all the plant motors. Push-button switches in various parts of the plant provide local control for all machinery. A motor-generator set produces 220-v. direct current for the magnetic separating pulleys. Crouse-Hinds conduit and Square D safety switches are used throughout.

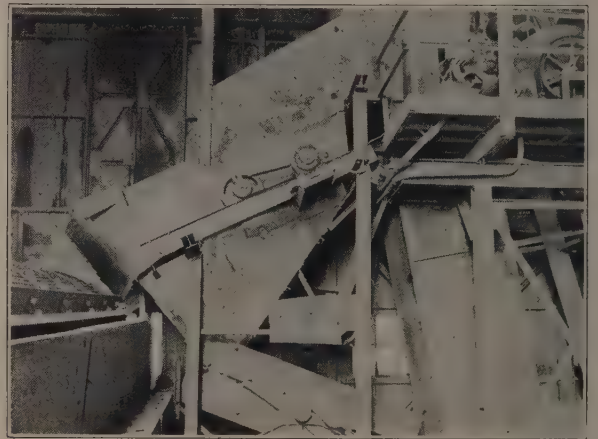
Provisions are also made to rinse or wash the slag when this treatment is specified or necessary for other reasons. This can be done by plugging



One of the single-deck vibrating screens with revolving screen at rear.



Above—Locomotive crane rehandling stock-piled slag at Buffalo Slag Co. plant at Lackawanna, N. Y. *In Circle*—The primary gyratory crusher. *Bottom, left*—Plant view showing cars on raw-material track, car being loaded with iron and the finished-material bins where railway cars and motor trucks are loaded. *Below*—First sizing of the slag is done by these double-deck vibrating screens. *Bottom, right*—Truck on scale at the office of the plant, Supt. C. Smith in the center foreground.





Bank of three transformers in the plant transformer house.



Magnetic head-pulley on return conveyor from crusher.



Switch-room and generator for magnetic separating pulleys.

in connections to a pipe-line at various points in the flow of the material. A vertical-type deep-well pump, driven by an integral Century 5-hp. motor, furnishes the water. A Buffalo Pump Co. 2½-in. centrifugal pump, driven by a 10-hp. General Electric motor, serves as an auxiliary. For cold-weather operation there are electric heaters on the top screening floor and on the crusher floor; other parts of the plant are heated with coke stoves. Traveling chain hoists over the screens and crushers are used for handling replacements or repairs.

The plant, as has been previously mentioned, is entirely of steel-and-concrete construction and has steel floors and stairs and large steel-sash windows. Bethlehem corrugated-metal siding and roofing is used to inclose the plant. Stearns belt-conveyor idlers are used exclusively and the conveyor belting is of four makes: Goodrich, Goodyear, Gutta Percha, and U. S. Dayton Cog-Belt drives are used on all the vibrating screens.

The plant office is a neat brick structure near the plant. This houses the general office, superintendent's office, wash-room, and weigh-room. Truck shipments are weighed by a Fairbanks 20-ton springless dial scale.

The main office of the Buffalo Slag Co. is at 866 Ellicott Square Bldg., Buffalo, N. Y. L. A. Beeghly is president; W. G. Scheub, vice-president; H. N. Snyder, secretary, treasurer, and general manager; and H. E. Rainer, assistant manager.



Main switches and recording instruments in the transformer house.

Lime Sales by Producers Show Drop of 20 Per Cent. in 1931

The sales of lime in 1931 by producers in the United States amounted to 2,710,000 short tons, valued at \$18,506,000, according to preliminary figures furnished by lime manufacturers to the United States Bureau of Mines. This is a decrease of 20 per cent. in quantity and 28 per cent. in value as compared with sales of 3,387,880 tons, valued at \$25,616,486 in 1930, and follows a decrease of 21 per cent. in quantity and 23 per cent. in value in 1930 as compared with 1929.

Small demand and lower prices were generally reported for all classes of lime, with decreases in output ranging from 8 per cent. to 75 per cent. for individual companies. Few reported increases.

Sales of lime in 1931 for construction are estimated at 970,000 tons compared with 1,204,614 tons in 1930, a decrease of 19 per cent. This followed a decrease of 27 per cent. in 1930 from the 1929 production. Sales of lime for chemical uses are estimated at 1,460,000 tons, a decrease of 21 per cent. from 1930 (1,840,155 tons). In 1930 there was a decrease of 20 per cent. from the 1929 sales. The sales of lime for agricultural use are estimated at 280,000 tons, a decrease of 18 per cent. in 1931 from 1930 (343,111 tons) and following an increase of 1 per cent. in 1930 from the 1929 figures. All the states producing lime except two, Florida and Massachusetts, showed decreases from the 1930 production, ranging from 5 to 75 per cent. in quantity and from 8 to 60 per cent. in value. In the majority of states the decrease in output was less than the decrease in value. In Florida the increase in output was due to local conditions; in Massachusetts, lime was supplied in considerable quantity to care for trade usually supplied by plants controlled by companies also operating in other states, where operations were curtailed in 1931.

Ohio, the leading state in the production of lime, had an estimated output in 1931 of 695,000 tons, valued at \$4,222,000, a decrease of 6 per cent. in quantity and 26 per cent. in value. Unsettled conditions were noted in this state, especially with reference to lime sold for construction, which usually takes about 60 per cent. of the output. Some producers reported a large reduction in the volume of this item and extremely low prices; others reported the volume of sales well maintained with a

LIME SOLD BY THE PRODUCERS IN THE UNITED STATES IN 1930 AND 1931

State	1930			1931 (estimated)		
	Total Lime		Hydrated Lime	Total Lime		Hydrated Lime
	Short Tons	Value		Short Tons	Value	
Ohio.....	736,305	\$5,711,855	471,785	695,000	\$4,222,000	430,000
Pennsylvania.....	633,520	4,661,670	234,192	480,000	3,200,000	186,000
Missouri.....	265,771	1,861,105	102,166	225,000	1,518,000	87,000
West Virginia.....	228,230	1,394,075	47,343	152,000	883,000	48,000
Alabama.....	164,822	929,302	21,380	139,000	758,000	22,000
Tennessee.....	147,648	855,452	36,670	130,000	708,000	35,000
Massachusetts.....	107,502	1,072,008	20,432	120,000	1,035,000	25,000
Virginia.....	146,996	960,219	63,253	99,000	635,000	40,000
Indiana.....	87,965	600,784	42,126	78,000	457,000	41,000
Illinois.....	39,709	721,143	32,322	71,000	565,000	26,000
Michigan.....	80,241	630,288	14,816	56,000	432,000	11,500
Texas.....	74,081	639,821	32,525	49,000	415,000	25,000
New York.....	83,078	702,475	37,586	49,000	400,000	21,000
California.....	51,302	498,795	1	41,000	390,000	14,000
Wisconsin.....	64,989	598,739	10,075	38,000	326,000	8,500
Maryland.....	53,090	398,841	34,287	35,000	290,000	22,000
Vermont.....	45,963	406,921	10,052	32,000	268,000	7,100
Arizona.....	35,642	317,881	1	29,000	287,000	1
Maine.....	66,775	542,115	1	29,000	240,000	1
Arkansas.....	30,349	241,938	1	1	1	1
Minnesota.....	1	1	1	1	1	1
Utah.....	27,522	236,607	1	1	1	1
Washington.....	26,913	266,131	1	21,000	208,000	4,400
Undistributed.....	639,467	1,368,321	118,552	142,000	1,269,000	74,500
	3,887,890	\$25,616,486	1,329,562	2,710,000	\$18,506,000	1,128,000

¹ Included under "Undistributed."

noticeable decline in prices. The same conditions prevailed in the chemical trade, and agricultural lime in some degree took the place of agricultural limestone on account of the low price at which the former was sold.

Ohio is also the largest producer of hydrated lime, the greater part of which is used in construction. The estimated sales of hydrated lime in Ohio in 1931 were 430,000 tons, valued at \$2,344,000, representing decreases of 9 per cent. in quantity and 34 per cent. in value from 1930.

Pennsylvania ranked next to Ohio in annual production of lime with an estimated output of 480,000 tons, valued at \$3,200,000, a decrease of 24 per cent. in quantity and 31 per cent. in value from 1930 figures. Pennsylvania also ranked second in the production of hydrated lime, the output for 1931 being estimated at 186,000 tons, valued at \$1,481,000, a decrease of 21 per cent. in quantity and 22 per cent. in value.

The accompanying table compares the estimated sales of lime in 1931, by states, with the sales in 1930.

Warner Co. Does the Unusual

(Continued from page 22)

All the operations of this plant are under rigid control and regular tests are made of the cement, aggregates, and concrete. A well-equipped laboratory on the mixer floor is separated by a partition. This is equipped to make all tests except the actual breakage of compression cylinders, which is done in Philadelphia. An inspector from an independent inspection bureau makes the routine tests and the laboratory is also used by state inspectors or others wishing to make additional tests.

The Warner Co. has always been one of the most progressive operators in the sand-and-gravel and lime industries and the same is true of its activities in the pre-mixed concrete industry in which it was a pioneer. It has been one of the leaders, at its Philadelphia plants, in the development of a method of pre-shrinking concrete in a mixer for a short

period before discharging it to the trucks which finish the mixing on the way to the plant. This method was one of the many subjects of interest discussed at the recent convention of the industry and promises to effect important economies in plant operation by increasing the capacities of plants and trucks with no increase in the original investment and without affecting the quality of the concrete produced.

Gravel Company Bought by Arundel Corp. Plans to Dissolve

A special meeting of stockholders of Columbia Sand & Gravel Co., Inc., was held at the company's office, Alexandria, Va., recently, to act on a resolution adopted by the company; directors deeming it advisable and for the benefit of the corporation that it be dissolved. Last February, acquisition of the company by the Arundel Corp. of Baltimore, was announced.

Assets of the company are said to be sufficient to pay for outstanding preferred stock at par with accumulated dividends and that upon dissolution, holders will be notified to present their stock and receive payment.

The latest edition of *Facts and Figures on Washington Securities*, compiled by Y. E. Booker and Co., lists the capitalization of the company as comprising an authorization of \$1,200,000 cumulative preferred stock of \$100 par value, of which \$1,046,000 is outstanding, and an authorization of 12,000 shares of no par common stock, unlisted, of which 10,460 shares are outstanding. Preferred stock of the company is listed on the Washington, D. C. stock exchange.

The company, which was the successor to the Columbia Granite & Dredging Corp., has been engaged in dredging sand and gravel and marketing it in the District of Columbia and surrounding territory.

Abstracts of Papers Read at the Zurich Congress on Testing Materials

European Authorities Discuss Water-Cement Ratio and Other Technical Cement Problems

A PREVIOUS series of abstracts from papers presented at the recent meeting at Zurich, Switzerland, of the First International Congress of the New International Assn. for Testing Materials dealt with stone and a general discussion of nonmetallic minerals. This instalment is composed of synopses of the papers which took up the various phases of the technology of cement, both as to its manufacture and chemical behavior in use. The third and final instalment will include abstract translations of the more important papers concerning concrete.

DR. GUSTAV HAEGERMANN, director of the laboratory of the Assn. of German Portland Cement Manufacturers: *Cement Testing When High Water Ratio Is Used.*

ONE of the objects of the old International Assn. for Testing Materials was the unification of the methods of test for cement and, especially, the standardization of the sand for standard-mortar tests. Schüle concluded that unification of the sand was impractical, but proposed in 1909 that cement be tested in prisms of 4 by 4 by 16 cm., as Feret had suggested, first in the bending test and then in testing compression on the broken halves. This proposal was based on a constant weight of dry constituents, a constant weight of mixing water, and a constant volume of mortar, but the researches of Gary and of Burchartz showed that the constant volume of mortar did not hold. Also, the variations were greater than in the tests with earth-dry mortar in the usual cube tests, while other investigations had indicated that tests on plastic mortar should not vary more than those on earth-dry mortar.

Ros proposed at the time of the Amsterdam congress that tests be made on a mortar made of 380 grams of standard sand and 127 grams of cement with a uniform 11-per cent. water content. This 11 per cent. is too low. A higher water content, however, requires the use of a graded sand, for the standard sand does not maintain its consistency with more water. The author suggests several possibilities for tests with graded sands, and reports a series of tests with graded sand using a 17.5-per cent. water content or a water-cement ratio of 0.70. Tests were made on cubes of 7.07-cm. sides, on 8-shaped tensile specimens, and on prisms of 4 by 4 by 16 and 4 by 4 by 20 cm. The tensile strengths varied in line with the strengths of the prisms in the bending tests, but the results of the compressive tests on the broken halves of the prisms varied from 90 to 110 per cent. as compared with compressive tests on the cubes. The prisms have the ad-

vantage of simplifying the testing procedure, but simplicity should not be achieved at the expense of exactness of results. The author urges the importance of further study and of the unification of the water content and the appropriate standard sand.

ANTONIO LOPEZ FRANCO, engineer of roads and bridges, professor at the Highway Engineering School, Madrid, Spain: *Concrete Construction and the Cement Industry in Spain.*

MR. FRANCO in this paper reviews the great development in the cement and concrete industry in Spain since the beginning of this century, corresponding with the period of great natural improvements in Spain, particularly in the regulation and utilization of its rivers, and corresponding also to the years of his connection with the industry. In 1900 there were only two Portland-cement plants in Spain, besides several hydraulic-lime plants and natural-cement plants, but the number has grown steadily since that time, except for a period of paralysis after the war. The increases in the use of cement and the technology of its use have grown in corresponding manner.

In spite of the rapid changes in equipment and the unceasing development of new machines and methods, all the Spanish plants have kept themselves modern. Practically all the plants mentioned in the paper use rotary kilns, either for the dry or for the wet process; most plants which originally installed vertical kilns have either replaced them with rotary kilns or have increased their size and efficiency by later improvements. Because of the importance of work in sea water, the Spanish specifications, both for strength and for resistance to the action of salt water, are high and great attention is paid to the manufacture of cements with these qualities.

PROF. Q. SESTINI and L. SANTARELLI, director and chief chemist respectively of the central laboratory of the "Italcementi" Fabbriche Reunite Cemento, S. A., Bergamo, Italy: *Ferrie Oxide in the Constitution of Cements and the Ferrous Cements.*

IN their microscopic analyses of ferrous cements, the authors have invariably ascertained that these cements are very rich in alite; iron is present in the form of celite, while belite is hardly ever encountered. The best ferrous cements have a very high lime ratio, CaO/SiO_2 , which approaches closely the theoretical maximum of 2.8; however, they never contain free lime. The synthetic products

($\text{CaO} \cdot \text{SiO}_2 \cdot \text{Fe}_2\text{O}_3$) appear as constituents of alite and celite, showing that alite is a tricalcic silicate free from alumina, a point which had not previously been determined. Ferric oxide appears to act as a more efficient stabilizer of tricalcic silicate alumina.

PROF. ITALO VANDONE, Dr. Ing., director of the "Istituto Sperimentale Stradale del Touring Club Italiano e del R. Automobile Club d'Italia," Milan, Italy: *On the World-Wide Standardization of Tests for Cement Mortar and Concrete.*

BEFORE the war the first International Assn. for Testing Materials did much useful work in laying the foundations for unification of methods of tests for cement and concrete. Since that time there have been great strides in the development of cement technology and in the employment of cement, yet we are no nearer any world-wide standardization of tests. The regulations proposed by the International association became official or passed into current practice all over Europe, but both Great Britain and the United States, large producers and users of cement, use different methods.



Prof. Italo Vandone.

After a review of the methods of test, on the continent and in Great Britain and the United States, the writer proposes as a start toward unification the development of world-wide standards wherever there are now no national specifications either in Europe or America, such as the flexural tests for mortars and concretes. Another work which would be very useful would be the development of coefficients and methods of conversion, whereby the results of American and British tests and those of European tests could be easily and quickly converted and evaluated with respect to each other.

H. MAITRE-DEVALLOIN, in charge of chemical tests at the Testing Laboratory of the Conservatoire National des Arts et Metiers, Paris: *Determination of the Mixing Ratio of Cement or Hydraulic Lime Mortars and Concretes.*

THE problem of determining the mixing ratio used in the production of a given mortar or concrete is a particularly important one because it is frequently carried out for the settlement of a controversy arising after the completion of a job. The difficulty of the analysis lies in the circumstance that the chemical elements of the cement or lime and the aggregates with which they are mixed are so nearly the same. If the exact chemical composition of both cement and aggregate is known, it is possible to compute the mixing ratio by a series of equations, but this method is rather prone to faults and errors. The laboratory of the Conservatoire

National des Arts et Metiers has used for several years a method depending on the determination (by treating with cold hydrochloric acid) of the soluble silica in the concrete or mortar under test. Since the soluble silica of siliceous sands and limestone is negligible, the result may be taken as the soluble silica of the cement or hydraulic lime, and the proportion of cement or lime in the concrete can then be computed by reference to the soluble silica of the unmixed cement or lime. In the case of cement the latter is assumed at 20 per cent. if no sample of the cement is available. However, there is no such figure for lime, the soluble silica of which may vary from 0 to over 20 per cent. in the case of eminently hydraulic limes. The author urges that samples of materials from all construction jobs be kept to guard against such need.

Since concrete is proportioned in France by the weight of cement to the volume of concrete (kilograms of cement per cubic meter of concrete), the formula used in the computation is:

$$P = 1,000 \frac{M \times d}{C}$$

in which

P = The weight of the cement or hydraulic lime in kg. per cu.m. of poured and set concrete.

C = The content of soluble silica in the cement or hydraulic lime (percentage by weight).

M = The content of soluble silica in the mortar or concrete (percentage by weight).

d = The apparent density of the poured and set concrete.

Prof. Dr. Georg Wiegner was born in Leipzig, Germany, in 1883, and studied chemistry at the University of Leipzig from 1902 to 1906. He then became an assistant and a private docent at the University of Göttingen, Germany, specializing in agricultural chemistry and colloid chemistry, working under A. Hantzsch in chemistry, W. Fleischmann in agricultural chemistry, and R. Zsigmondy in colloid chemistry. Since April 1, 1913, he has been professor of agricultural chemistry at the Swiss Federation Technical College at Zurich, and since 1922 president of the Swiss Commission for the Study of the Preservation of Concrete Pipes in Drainage Soils. He is the author of *Boden und Bodenbildung in kolloidchemischer Betrachtung*, which was issued in its sixth edition in 1930. He is a member of the Hungarian Academy of Sciences and of the Czechoslovakian Academy of Agriculture.

Antonio Lopez Franco completed the course of highway engineering in 1904 and during the years succeeding served in the public works departments of Toledo, Canarias and Segovia, and in the railway service. Later, in the Grasset construction organization, he specialized in the design and construction of hydraulic works in reinforced concrete and in the erection of cement plants. In 1920 he was named engineer in charge of the laboratory of the Highway Engineering School at Madrid, and in 1924 became a professor of that institution with the chairs of chemistry and construction materials. He has in the meantime carried on his professional work in his specialty. In 1928 he was named consulting engineer of the Confederacion Sindical Hidrografica del Ebro (now Man-Comunidad).



Prof. Georg Wiegner.

PROF. DR. GEORG WIEGNER, Eidgenössische Technische Hochschule (Federation Technical College), Zurich, Switzerland: *Chemical Actions on Cement and Concrete in the Ground.*

THIS report is based in large part on the investigations of the Swiss Commission for the Study of the Preservation of Concrete Pipes in Drainage Soils, which was founded in 1922. The influences on concrete in the ground are attributed to the hydrogen-ions, magnesium-ions and sulphate-ions resulting from dissociation and cationic exchange (rarely) in strong acids, (sometimes) in carbonic and ulmic acids, and (especially) in clays and humus materials, magnesium bicarbonate, soluble sulphates. Investigations of H. Gessner (for the commission) show as limits for the damaging of concrete drainage pipes: Acid reaction in ground (pH under 6); high interchange acidity (degree of acidity in Baumann-Gully test over 20 cu.cm. n/10 acid to 100 gr. of soil, shaken with 200 cu.cm. n/1 sodium acetate); high sulphate content in ground (over 0.2 per cent. SO_3 , soluble in hot hydrochloric acid); high magnesia content in the soil (over 2.0 per cent. MgO , soluble in hot hydrochloric acid). These figures were verified by practical tests on concrete pipes laid in Switzerland, principally in low marsh soil.

It has been shown that the chemical resistance of concrete pipes depends strongly on the cement-aggregate ratio, the resistance increasing with increased cement content. The method of manufacture also has great influence, those best made being still intact after six years, and some poorly made having deteriorated almost at once. The chemical resistance was also compared with compressive strength, density, porosity, and permeability. The compressive strength and resistance to chemical attack are only roughly parallel; some with high strength are low in chemical resistance, and *vice versa*. Porosity seems a much better index of chemical resistance, as the resistance increases as the porosity and the permeation of water decrease.

PROF. DR. R. GRÜN, director of the Research Institute of the Blast-Furnace Cement Industry, Düsseldorf, Germany: *Cements with Hydraulic Admixtures.*

THOROUGH-GOING investigations reported in this paper consider hydraulic admixtures according to energy of hardening, physical structure, and chemical composition. Studied according to their energy of hardening, they show themselves divided into two groups: (1) Vitreous blast-furnace slags with high energy of hardening, and (2) pozzuolan materials of natural origin (pozzuolana, trass, etc.) or of artificial origin (brick dust, etc.), with considerably less energy of hardening. As regards physical structure, all hydraulites contain vitreous and many also contain crystalline components. The amorphous state is obviously the more favorable for hardening; whether the crystalline components also take part in the hardening is not yet ascertained.

The total chemical analysis is of minor importance, the more important factors being the acid-soluble and the alkali-soluble proportions. In this regard also the hydraulites fall into two groups: (1) Vitreous blast-furnace slags with comparatively high lime-content of 35 to 50 per cent., which are completely soluble in acid; and (2) the largely acid-soluble hydraulites with lower lime content.

Tests were made on a large series of different hydraulites, determining their effect on strength and on resistance to salt water, both when used as replacing part of the cement in the concrete mix and when used simply in addition to the cement. Only hydraulites of group 1 (blast-furnace slags) are capable of replacing cement in the mix and then only when finely ground; all others diminish the strength greatly if they replace cement.

In the tests on hydraulites of group 1 (hydraulites with high lime content, soluble in hydrochloric acid, that is, blast-furnace slags) slag was added to replace the Portland-cement clinker, beginning with 10 per cent. and continuing through 20, 30, 40, 50 up finally to 60 per cent. After chemical investigations these admixtures were divided into three groups: (a) low-alumina, (b) high-alumina, and (c) high-magnesia.

In the first case, increasing replacement of Portland cement by slag reduced the tensile strength very little, the compressive strength slightly more. The reduction was least in the case of slags with high lime content, although the more-acid slags showed very energetic hardening in the later periods. On the other hand, the resistance to salt water is less with high lime content. It is possible to produce a cement with satisfactory strengths and very high resistance to salt water if a slag of proper constitution is used and if a sufficiently-high proportion of slag is employed, usually between 70 and 80 per cent.

The high-alumina slags with alumina content of 19 per cent. give cements with very good hardening capacity, especially in the earlier periods, and good resistance to salt waters, with excellent subsequent hardening in water storage. With falling alumina content the hardening capacity is somewhat less.

The high-magnesia slags have an especially favorable action on the hardening capacity and on the resistance to salt water, if not present in too great quantities. In spite of high magnesia contents, such as 18 per cent., there is no cracking as in Portland cement—an indication that the magnesia is combined in a form different from that in the case of cement clinker.

Two main series of tests were made on hydraulites of the second group (natural pozzuolans, low-lime content, only partially soluble in acid), on trass and on diatomaceous earth. Trass was tested both in lime-trass mortar and in cement-trass mortar. In lime-trass mortar there occurred the well-known slow participation in hardening, hence comparatively-low initial strengths. The resistance to salt waters is not higher than that of other mortars, as that of Portland cement, and is less than that of blast-furnace-cement mortars. In cement-trass mortar, investigations were again

made by using the hydraulicite to replace and also to supplement cement. It was established that, as a replace of cement it always reduces strengths, while used simply as an admixture, especially in case porous sand is used in the mortar, the strengths are increased. But the same increases of strength can be obtained in about the same measure with the customary inert stone dust. It was found that the useful admixture proportion is from 25 to 40 per cent. of the weight of the cement, and that water storage is more favorable to the use of trass than air storage; in water it is superior to stone dust. As was to be expected, blast-furnace cement is also favorable to trass admixture, since the slag is a quite different hydraulicite from trass because of the high lime content in one case and the low lime content (about 2 per cent.) in the other. Here, also, the trass aids in creating resistance to salt-water action. It could not be proved that mixing trass with cement at the factory is any more useful than mixing on the job. If mixed at the factory, the proportion of admixture must of course be taken into account when adding cement to the concrete mix.

In graded sands the action of trass or of stone dust is less favorable than in the case of standard sands with their higher percentage of voids. The increases in strength from trass in standard-sand mortars is thus not to be expected in equal measure when mortar is made from Rhine sand; also the decrease of strength is greater in the latter case if trass replaces part of the cement.

Diatomaceous earth was investigated in the form of Moler cement, the analysis of which indicated that about 25 per cent. of diatomaceous earth (*Molererde*) was present in the cement. This cement, obtained from Denmark, at first lagged behind standard Portland cement in tensile strength,

but later surpassed it. The compressive strength was appreciably less than that of the Portland cement tested for comparison. In ammonium-sulphate storage, Moler cement showed itself clearly superior to Portland.

FABIO FERRARI, Dr. es Sc., professor of applied chemistry at the Royal School of Engineering, Pisa, Italy: *Cements and Pozzuolanic Substances.*

LIME set free during the hydration of cement constitutes its "element of weakness"—being soluble and likely to maintain an alkalinity sufficient for the stability of strongly basic acids from which the destructive sulfo-aluminates may form and, changing in only limited quantities to compact and adherent carbonate, it is the essential cause of permeability and short life of concrete under certain conditions. The correction of this condition theoretically depends on the addition to the cement of a material capable of fixing the lime set free in hydration in a form of low basicity and capable of taking on a final composition practically stable in conditions that tend to destroy concrete. These theoretical considerations have been verified by studies of many investigators, and by practical addition of pozzuolanic materials to cement. Nevertheless, the solution has been only partial; the pozzuolans contain inert materials with little or no adherence, and they fix the lime more slowly than it is set free in hydration, so that destructive action can take place before the fixation is complete. The ideal cement, therefore, would be one in which a basic cement, free from inactive components, were intimately mixed, in correct proportions, with a pozzuolana composed entirely of active elements and capable of hydrating at the same rate as the cement itself. The question of maximum percentage of hydraulicites in relation to cement clinker can be considered practically solved. The basic-siliceous cement, with a hydraulic modulus from 2.27 to 2.30 and a silicic modulus from 3.00 to 3.20, has proved particularly suitable; it has been produced commercially since 1922 and is of the type to-day known as Velo cement. No such definite conclusions are possible concerning the highest proportion and the best quality of elements contained in the pozzuolanic material, but the results of the studies thus far indicate that a solution of this question is imminent.

S. Bazzocchi and C. Vittori were able by heat treatment or calcination of natural pozzuolana, the details of which are not available, to produce a pozzuolanic material with properties hitherto unprecedented; in one case, where natural pozzuolana and lime in standard-mortar tests gave compressive strengths of 46.5 kg. per sq.cm. at 28 days and 122.8 at 180 days, the calcined pozzuolana and lime gave corresponding strengths of 239.0 and 374.5 kg. Similarly, a mixed cement made from calcined pozzuolana and Portland cement gave results well ahead of the standard Portland cement used for comparison.

Prof. Dott. Fabio Ferrari has long devoted himself to the study of construction materials, and has been active both in experiment and in the development of theory, particularly in the field of hydraulic cementing materials. He has made many contributions toward the solution of scientific and technical questions relating to high-strength cements and the pozzuolanic materials, the use of which, in Italy, he has greatly developed.



Prof. Fabio Ferrari.

Prof. Dr. Richard Grün was born in Mannheim, Germany, on July 23, 1883, and graduated from the Mannheim preparatory school in 1903. From 1903 to 1909 he was engaged in study at Jena and at Kiel, and in 1908 and 1909 served as assistant in the chemical institute of the University of Jena. In 1910-11 he was assistant at the chemical-technical experiment station of Dr. H. Passow at Blankensee, and from 1911 to 1914 director of the Hansa-Filterwerke, Haiger. In 1918 he returned to Dr. Passow's experiment station as staff-member; this station in 1921 was removed to Düsseldorf and became the Research Institute of the Blast-Furnace-Cement Industry, of which Dr. Grün in 1922 became director, a post he now holds. In 1930 he was named honorary professor of the Technical College of Aachen.

MEN OF THE INDUSTRY

The portrait printed on this page in each number of PIT AND QUARRY is selected without significance as to current events or the position of the individual in the industry.



C. A. SWIGGETT
Superintendent.
Lehigh Portland Cement Co.
Iola, Kan.

Coming Events

March 1-2, 1932. Washington, D. C. Annual meeting, Concrete Masonry Assn., Wardman Park Hotel.

March 1-4, 1932. Washington, D. C. Twenty-eighth annual convention, American Concrete Institute. Harvey Whipple, secretary-treasurer, 2970 West Grand Blvd., Detroit, Mich.

March 7-11, 1932. Cleveland, O. Annual Group meetings of committees, American Society for Testing Materials. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

March 10, 1932. St. Louis, Mo. Monthly meeting, St. Louis Quarrymen's Assn., Forest Park Hotel. E. J. McMahon, exec. sec., 4063 Forest Park Blvd., St. Louis, Mo.

March 15-16, 1932. Chicago, Ill. Annual convention, American Railway Engineering Assn., Palmer House, E. H. Fritch, secretary, 59 E. Van Buren St., Chicago.

June 20-24, 1932. Atlantic City, N. J. Annual meeting of American Society for Testing Materials. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

Gravel Co., Brainerd, Minn.; Hugenot Sand & Gravel Co., Richmond, N. Y.; Corydon Crushed Stone & Lime Co., Corydon, Ind., and Chilhowee Stone Co., Knoxville, Tenn.

Conducts Exhibition of Motor-Control Equipment

The Allen-Bradley Co. of Milwaukee, Wis., has arranged a comprehensive exhibition of motor control—a radical departure from the usual small booth exhibits at trade or power shows—on the fifth floor of the Engineering Bldg., Chicago. In the completeness of working displays and in the large area of floor space used, the exhibition sets a high mark as an educational display of control equipment. The exhibit opened Feb. 1 and is to continue until Feb. 29.

The controls shown range in size from small push-button stations and photoelectric relays to automatic high-tension motor starters of several hundred horse-power rating.

A Correction

The January 27, 1932, issue of PIT AND QUARRY carried an item on the murder of George A. Colgan, Jr., in the offices of the Seaboard Sand & Gravel Co. in New York. The item stated that Mr. Colgan was formerly sales manager of the company and that the company had "long been allied with New York political groups and ill feeling over alleged shady deals in awarding of sand-and-gravel contracts was said to be behind the slaying, according to New York newspapers."

W. Butler Duncan, president of the Seaboard company, has written the true facts in the case. According to Mr. Duncan, the late Mr. Colgan was never connected with the Seaboard company in any capacity. Mr. Colgan and John Ragonetti came to the offices of the Seaboard company on December 28, 1931, with their respective attorneys for the purpose of arbitrating differences between them before James G. Shaw, vice-president of the Seaboard company, as arbitrator. These differences, according to Mr. Duncan, had no connection whatever with the Seaboard company.

In the course of the proceeding, Mr. Ragonetti became angry at Mr. Colgan, drew a pistol and, in spite of Mr. Shaw's efforts to restrain him, shot and killed Mr. Colgan. Immediately thereafter he shot himself and died within a few days.

The Seaboard company has never been allied with any political group, nor has it ever been involved in any improper dealings, and PIT AND QUARRY regrets that the previous item was published in its original form.

Pumpings from the Old Pit

Excerpts from the old files of PIT AND QUARRY reveal many interesting sidelights on the activities of the pits, quarries and plants of former days. These are printed in this column each issue.

Fifteen Years Ago

SAND-AND-GRAVEL producers in the Chicago area and northeastern Illinois formed a coöperative organization to further the interests of the industry in that region. Sponsors of the movement were N. C. Fisher of the American Sand & Gravel Co.; C. H. Stebbins, Lake Shore Sand Co.; Frank W. Renwick, Chicago Gravel Co.; and B. H. Atwood of the Atwood-Davis Sand Co., all of Chicago.

* * *

The Tenth Annual Chicago Cement Show was held February 7-15, 1917, at the Coliseum, Chicago. The exhibit was presented under the auspices of the Cement Products Exhibition Co. During the same week the American Concrete Institute held its annual gathering at the Hotel Sherman, Chicago.

Ten Years Ago

THE engineering firm of Richard K. Meade & Co. of Baltimore, Md., was preparing plans for the proposed erection of a Portland-cement plant near Birmingham, Ala., by the newly-incorporated White Star Portland Cement Co. A. G. Connolly was president of the concern and W. K. Shafer was secretary.

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Fire caused damage estimated at \$75,000 at the slag-crushing plant of the Standard Slag Co. of Sharpsville, Pa.

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The New England Lime Co. of Danbury, Conn., announced plans for the rebuilding of its plant at New Milford which had been destroyed by fire with a resultant loss of about \$200,000.

At the annual meeting of the Indiana Crushed Stone Assn. the following officers were elected to serve during 1922: Charles N. Hodgins, Kokomo Stone Co., Kokomo, president; Bernard J. McNulty, Lehigh Lime Co., Chicago, vice-president; B. G. Pogue, Spencer Stone Co., Indianapolis, treasurer; and F. W. Connell, Indianapolis, secretary.

* * *

The Glens Falls Portland Cement Co. of Glens Falls, N. Y., reduced its working day from 10 to 9 hours and effected a general reduction in wages of its employees of about 15 per cent.

Five Years Ago

OPERATIONS were started at the second Brixment plant of the Louisville Cement Co. of Speed, Ind., which had been under construction in the preceding year.

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The Standard Slag Co. of Youngstown, O., and the Bessemer Lime-stone & Cement Co. completed a consolidation, the combined assets of the merged company being placed at approximately \$15,000,000.

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Four new directors were elected to fill vacancies on the board of the Universal Gypsum & Lime Co. They were: Norman G. Hough, R. G. Rankin, C. F. Kaler and F. A. Krumholz. Mr. Hough was also named vice-president in charge of sales.

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New incorporations included the following: Ocala-Tampa Lime Rock Co., Tampa, Fla.; Huron Gravel Co., Detroit, Mich.; Becker County Sand &

Personal Mention

John Halquist has acquired five acres of land near Oconomowoc, Wis., containing limestone deposits. Mr. Halquist will engage in the crushed-stone business, according to reports, plans now being in preparation for the opening of a quarry.

Charles Kelly, 28, an employee of the Dewey Portland Cement Co. plant at Buffalo, near Davenport, Ia., was severely burned recently following an explosion of pulverized coal at the plant. Carl Babcock, another workman, was also injured but only slightly.

O. W. Robertson, president of the Western Lime & Cement Co. of Milwaukee, producers of crushed stone, lime and dealers in cement, was re-elected president of the company at the annual meeting held at Milwaukee. **R. C. Brown** of Oshkosh, Wis., was again named vice-president and **V. F. Nast** secretary and treasurer. Members of the board of directors include, besides the above officers, **August Nast** of Marblehead, Wis.; **H. A. Nast** and **W. J. Nast** of Fond du Lac; **P. C. Waite** of Oshkosh; **Bert B. Williams** and **E. Robertson** of Milwaukee. The company operates nine quarries and plants at or near the following Wisconsin towns: Brillion, Eden, Grimms, Green Bay, Hamilton, Hayton, Knowles, Quarry, and Sherwood.

H. F. Tyler, vice-president of the Dewey Portland Cement Co. and general manager of the company's plant at Davenport, Ia., has been elected vice-president of the Manufacturers' Bureau of the Davenport Chamber of Commerce for 1932, following the annual meeting of the organization, held recently.

Bruce Burrier, 27, was injured recently while at work in the France Stone Co. quarry at Fremont, O. Mr. Burrier suffered a deep cut in the forehead when he slipped and fell against a gasoline locomotive while attempting to crank the engine.

L. E. Andrews, engineer in New York for the Portland Cement Assn., addressed the members of the Westchester County Society of Civil Engineers at White Plains, N. Y., recently. Mr. Andrews discussed the technical aspects of concrete making.

J. R. Rue, managing engineer of the motor department of the General Electric Co., Pittsfield, Mass., plant, has been assigned to special work at Schenectady. He had been at Pittsfield since 1912. **K. R. Van Tassel**, designing engineer of the same department, has been transferred to the Fort Wayne works.

William H. Sallwasser, formerly connected with the James H. Bean Fdry. Co., has become affiliated with the Alloy Steel & Metals Co. of California, Inc. at Los Angeles. According to Mr. Sallwasser, the company is soon to make an important announcement concerning its improved line of crushing equipment.

George P. Torrence, vice-president of the Link-Belt Co. and general manager of the two Indianapolis plants since 1925, has left for Chicago to become acting president of the company. **James S. Watson**, who, under Mr. Torrence, has been in charge of the Dodge plant of the company, will become vice-president and general manager of the two Indianapolis plants, with **F. S. O'Neil** assistant general manager.

Paul Crouse, assistant manager of the Ames, Baldwin, Wyoming Shovel Co. plant at Anderson, Ind., has left for Northeaston, Mass., where he will be connected with a unit of the company there.

Duff A. Abrams, consulting engineer, with offices at 342 Madison Ave., New York, N. Y., who retires this year as president of the American Concrete Institute will be presented the Henry C. Turner Gold Medal at the annual convention of the Institute March 3 at Washington, D. C. The medal is awarded not oftener than once each year for "notable achievement in or service to the concrete industry," the special citation in the case of Professor Abrams being: "For the discovery and statement of important fundamental

principles governing the properties of concrete and reinforced concrete." This is the fourth Turner medal since the founding of the award in 1928. Prof. Abrams was for many years in charge of research for the Portland Cement Assn. and later director of research for the International Cement Corp. He has just returned from a European trip.

F. A. Fischrupp, of 217 N. Myers St., Charlotte, N. C., is reported to have acquired a tract of land at Spruce Pine, N. C., containing deposits of feldspar and mica, and will install equipment for developing the deposit.

A. E. Ashcraft, for 10 years engaged in engineering and service work for Sauerman Bros., Inc., has been named distributor in western Pennsylvania, northern West Virginia and the border counties of Ohio for Sauerman Bros. and the Clyde Iron Works. Mr. Ashcraft will make his headquarters at 31 S. Grandview Ave., Pittsburgh.

C. E. Wilson for the past nine years general sales manager of the Worthington Pump & Machinery Corp. of Harrison, N. J., has been appointed vice-president in charge of industrial relations. Mr. Wilson has been a member of the Worthington organization since 1899 when he joined the Chicago branch office as a salesman. **Clarence E. Searle**, who recently resigned as general representative in charge of sales of Allis-Chalmers Manufacturing Co., has been made vice-president in charge of sales of the Worthington company.

Jess Drifill, of McCordsville, Ind., has acquired a gravel pit at Cartersburg, Ind., from G. W. Wray of Danville, and plans to operate this spring.

Obituary

C. A. Hawkins, superintendent of the Arkadelphia Sand & Gravel Co. plant at Arkadelphia, Ark., met his death recently in an airplane crash. He has been succeeded by **B. F. Hawkins**.

Frank E. Milligan, age 69, owner of the Sidney Washed Gravel Co. of Sidney, O., died suddenly at his home in Sidney recently. Death was due to apoplexy. Mr. Milligan had been a resident of Sidney, O., since 1920. He formerly resided at Bellefontaine, O. He is survived by two sons and three daughters.



Duff A. Abrams.

Traffic News and Comment

Recent I. C. C. Decisions

Crushed Stone, Sand and Gravel.—Commissioner Lewis, in summarizing the commission's findings in the rehearing of the Illinois sand-and-gravel cases—which rehearing was made necessary by court proceedings instigated by the C. & E. I. Ry. in which the original order of the commission was enjoined—says, "On further hearing, rates to destinations in Illinois, on and south of the Terra Haute-St. Louis line of the Pennsylvania Railroad, on sand, gravel and crushed stone in car-loads from producing points in Indiana; on crushed stone in car-loads from Marquette and Cape Girardeau, Mo.; and on chat in car-loads from producing points in Missouri, are prescribed or approved as reasonable and non-prejudicial for interstate application.

"Intrastate rates on crushed stone, in car-loads, from Thornton, Ill., to certain destinations in southern Illinois are found unduly preferential of the shipper of crushed stone at Thornton and unduly prejudicial to the shipper of gravel at Summit Grove, Ind., and to shippers of crushed stone at Greencastle, Ind.

"Undue prejudice and undue preference ordered removed.

"Findings in prior report in Nos. 21,939 and 21,372 and Investigation and Suspension Docket No. 3,093, 160 I. C. C. 507, modified in part.

"Interstate rates on sand and gravel, in car-loads, from Cayuga (Dickason Pit) and Montezuma, Ind., to certain destinations in central and southern Illinois found unreasonable. Reasonable rates prescribed for the future in Nos. 23,707 and 24,298.

"Proposed increased and reduced rates on agricultural and ground limestone, in car-loads, from Mosher, Mo., to destinations in southern Illinois found not justified, and reasonable and non-prejudicial rates prescribed in lieu thereof. Proposed schedules in I. & S. Docket No. 3,604 ordered cancelled."

Part of these cases were heard co-operatively with the Indiana commission and the others with the Illinois commission. In dealing with the single-line intrastate rates of the C. & E. I. the report reads, "That the intrastate single-line rate on crushed stone, in car-loads, maintained by the C. & E. I. from Thornton, Ill., to destinations south of Mt. Vernon, Ill., to and including Marion, Ill., is, and for the future will be, unduly preferential of the shipper of crushed stone at Thornton and unduly prejudicial to the shipper of gravel at Summit Grove, Ind., and to the shippers of crushed stone at Greencastle, Ind., to the extent that said rate from Thornton is, or may be, less than the inter-

state single-line rate maintained by the same carrier on gravel, in car-loads, from Summit Grove, and to the extent that said rate from Thornton is, or may be, more than 14 c. lower than the interstate rate for joint-line movement in connection with the same carrier on crushed stone, in car-loads, from Greencastle, and that this undue prejudice and undue preference should be removed by maintenance of the present single-line rate of \$1.12 on said interstate traffic from Summit Grove, by the establishment and maintenance of a joint rate of \$1.26 on said interstate traffic from Greencastle, and by the establishment and maintenance of a single-line rate of \$1.12 on said intrastate traffic from Thornton. This is the only instance where it is necessary for us to prescribe lawful relationships between intrastate and interstate rates in these proceedings as the Illinois commission is prescribing or suggesting other intrastate rates which are in harmony with the interstate rates prescribed herein." Revised rates are to be made effective not later than Mar. 31. I. C. C. Docket No. 21,939, sand, gravel and crushed stone from Indiana and Illinois points to destinations in Illinois; I. & S. Docket No. 3,093, sand, gravel and crushed stone from Indiana points to destinations in Illinois; No. 21,372, Ohio & Indiana Stone Co. v. C. C. C. & St. L. et al.; No. 23,707, Dickason Sand & Gravel Co. v. B. & O. et al.; I. & S. No. 3,604, limestone from Mosher, Mo., to Illinois points; No. 24,298, Montezuma Gravel Co. v. B. & O. (An abstract of the examiner's report in these cases appeared in PIT AND QUARRY, July 1, 1931, page 80.)

Crushed Stone.—The commission has found the rates on crushed stone or marble terrazzo material from Gantt's Quarry, Ala., to destinations in Texas and other points in the Southwest unreasonable and unduly prejudicial, shippers at Whitestone, Ga., being preferred. The undue prejudice and preference is to be removed not later than Apr. 18, by the establishment of rates from both of the above points on a basis of 12 per cent. of the contemporaneous first-class rates. An emergency charge of 12 c. a net ton, authorized in Ex Parte 103 is allowed. I. C. C. Docket No. 23,626, Alabama Marble Co. v. L. & N. (Examiner's report abstracted in PIT AND QUARRY, July 1, 1931, page 80.)

Plaster.—The commission has found the rates on plaster from interior mills in Utah, Montana, Wyoming and Nevada to Seattle, Wash., Portland, Ore., and intermediate points not in violation of Sec. 1 and 3, and has dismissed the complaint in Docket No.

18,693, in which it was alleged that rates from Seattle, Wash., were preferential. Rates on plaster from Gerlach, Nev., to Astoria, Ore., Vancouver, Felida, Knapp, Chehalis, Hoquiam, Olympia, Tacoma, Seattle, Richmond Beach, Everett, Longview, Bellingham, Blaine and Sumas, Wash., were found to be unduly prejudicial to the complainant at Gerlach to the extent that they exceeded the rates on plaster in effect from Hanover and Heath, Mont., Gypsum and Sigurd, Ut. and Laramie, Wash.; the undue prejudice to be removed by May 2. As complainant failed to show proof of damage, reparation was denied. In rehearing Dockets No. 16,339 and 19,311, no evidence was introduced which warranted a modification of the reports on the original hearings in 139 I. C. C. 703 and 140 I. C. C. 373. I. C. C. Dockets No. 18,693, Standard Gypsum Co. v. Union Pacific et al.; No. 18,909, Pacific Portland Cement Co. Consolidated v. Western Pacific et al.; No. 16,339, Three Forks Portland Cement Co. v. C. M. St. P. & P. et al.; and No. 19,311, Standard Gypsum Co. v. Southern Pacific et al.

Examiners' Reports

Agricultural Lime.—Examiner Charles W. Berry proposes that the commission award reparation on a finding that the charges on agricultural lime from Berkeley, W. Va., to Virginia destinations were unreasonable to the extent that they exceeded those that would have accrued at rates prescribed in North American Cement Corp. v. A. & R., 153 I. C. C. 432, and 163 I. C. C. 701. I. C. C. Docket No. 24,456, Bone Dry Fertilizer Co., Inc. v. A. C. L. et al. (PIT AND QUARRY, June 15, 1931, p. 66.)

Cement.—Examiner Carl A. Schlager recommends that the commission find the rates on cement from Dewey, Okla., to Madisonville and Wichita Falls, Tex., applicable, and that reparation be awarded on a further finding that the rate on shipments from Dewey to Wichita Falls between Mar. 22, 1930, and June 28, 1930, was unreasonable to the extent that it exceeds 24 c. car-load minimum weight 50,000 lb., subject to the marked capacity of the car but not less than 40,000 lb. Claims for reparation on shipments from Dewey to Madisonville and other shipments from Dewey to Wichita Falls should be barred. I. C. C. Docket No. 24,728, Dewey Portland Cement Co. v. A. T. & S. F. et al.

Crushed Stone.—Claiming that the overcharge on crushed stone from Marquette, Mo., to Memphis, Tenn., was barred by the statute of limitations, Examiner William G. Butts has

proposed that the commission dismiss the complaint in I. C. C. Docket No. 24,710, Gauger-Korsmo Construction Co. v. M. P. et al.

Sand.—Examiner W. A. Maidens proposed that the commission award reparation of \$948.19, on finding that the rate on sand from Leavenworth, Kan., to New Market, Mo., was unreasonable to the extent it exceeded 3 c. per 100 lb. I. C. C. Docket No. 24-393, Dresser Sand Co. v. C. G. W. (PIT AND QUARRY, June 3, 1931, page 68.)

New Complaints Filed

Plaster Retarder.—New rates and reparation are sought on a complaint of unreasonable rates and charges on plaster retarder from McCook, Ill., to Los Angeles and Long Beach, Cal., and Ludwig, Nev., in I. C. C. Docket No. 24,987, Standard Gypsum Co., Inc., San Francisco, Cal., v. A. T. & S. F. et al.

Sand and Gravel.—The C. M. St. P. & P. requests fourth-section relief in connection with rates on sand and gravel from Eau Claire to Oakdale and Tomah, Wis.

F. S. A. No. 14,633.

Rate-Committee Dockets

New England Freight Assn.

Sand.—To meet motor-truck competition shippers propose that the rates on common sand and gravel¹, from North Wilbraham and Westfield, Mass., to Oak Street, Bondsville, Enfield, Greenwich and Greenwich Village, Mass., be reduced to 50 c. a net ton, to expire Sept. 1, 1932.—Docket No. 24,350.

Trunk Line Assn.

Lime.—Carriers propose to establish on (a) building lime and on (b) agricultural, land, chemical, gas and glass lime, car-load minimum weight 30,000 lb., from the Western Maryland Cavetown-Pinesburg district and Thomasville-Bittinger district, rates shown below.—Docket No. 28,314, Sup. 1.

To	Proposed Rates
	(a) (b)
Hutchinson to Rogers Mills, Pa.	15½c. 13½c.
Millers Crossing to Jones Mill, Pa.	16c. 14c.

Central Freight Assn.

Cornwall Stone.—Shippers are asking for a reduction in the rate on ground cornwall stone, car-load minimum weight 50,000 lb., from East Liverpool, O., to Sheboygan, Wis., from 32 c. (6th class) to 23 c., to apply via car-ferry routes across Lake Michigan through Toledo, O., and Detroit, Mich.—Docket No. 30,408.

Crushed Stone.—A reduction in the rate on crushed limestone, car-load minimum weight 50,000 lb., from Bedford, Ind., to Ottawa, Ill., from \$2.30 to \$1.90 a net ton is proposed by shippers.—Docket No. 30,431.

Shippers of crushed stone and related articles are proposing a line of commodity rates for shipments in open-top cars, from Painesville, O., to points in Ohio, New York and Penn-

sylvania, where the 6th-class rate now applies. Representative proposed rates are: Akron 90c.; Andover and Bedford 80c.; Bundysburg 70c.; Cleveland 60c.; Crestline \$1.05; Dunkirk, N. Y., and Franklin, Pa., \$1.10; Girard 85c.; Hudson 85c.; Kent and Lorain 90c.; Northeast, Pa., \$1.00; Ravenna, O., 90c.; Stoneboro \$1.00; Swanville, Pa., 80c.; Westfield, N. Y., \$1.00.—Docket No. 30,433.

Firestone.—A reduction in the rate on firestone, car-load minimum weight 60,000 lb., from New Castle and Eastbrook, Pa., to Detroit, Mich., from \$2.65 to \$2.40 a net ton is proposed by shippers.—Docket No. 30,393.

Sand.—Shippers at Michigan City, Ind., propose that the rates on beach and lake sand to Cambridge City and Connersville, Ind., be reduced from \$1.76 and \$2.02 a net ton, respectively, to \$1.50 a net ton.—Docket No. 30,394.

Slag.—Establishment of a commodity rate of \$3.35 per net ton on granulated slag in open-top cars to Speed, Ind., from Pittsburgh, Munhall, Kenney Yard, Bessemer, Duquesne, and South Duquesne, Pa., is proposed by shippers. The 6th-class rate now applies.—Docket No. 30,401.

Illinois Freight Assn.

Cement.—It is proposed to reduce the rate on cement from Chicago, Ill., to Bristol, Pleasant Prairie, Salem and Woodworth, Wis., from 10½c. to 9½c.—Docket No. 6,441.

Crushed or Pulverized Stone.—It is proposed to reduce the rates on crushed, ground or pulverized stone¹, from Krause and Valmeyer, Ill., to Ottawa, Ill., from \$2.08 to \$1.55 per net ton.—Docket No. 6,467.

Western Trunk Line Committee

Cement.—It is proposed to establish on cement, car-load minimum weight 50,000 lb., from Paducah, Ky., I. C. C. Docket No. 8,182 scale rates to points in Missouri to which Scale 2 rates apply from points in the Kansas gas belt, Linwood, Ia., and Missouri producing points such as Ilasco, Prospect Hill, Alpha, Marquette and Sugar Creek, and to establish Scale 3 rates to points in Missouri to which Scale 3 rates apply from the points referred to above.—Docket No. 7,820.

A reduction in the rate on cement, car-load minimum weight 50,000 lb., from Rapid City, S. D., to Minneapolis, Minnesota Transfer and St. Paul, Minn., from 25c. to 20½c. per 100 lb., is proposed.—Docket No. 5,549-F.

Shippers propose a reduction in the rate on cement as shown in Item 10-A, W. T. L. Tariff 132-H, from Louisville, Neb., to Council Bluffs, Ia., from 8½c. to 8c. per 100 lb.—Docket No. 6,549-E.

Crushed Stone.—It is proposed to reduce the rate on crushed stone¹, from Ely, Minn., to Chicago, Ill., from 13½c. to 12c. per 100 lb.—Docket No. 2,292-I.

Lime.—The present rates on lime from Mosher and Ste. Genevieve, Mo., to Mitchell, S. Dak., are 38½c., car-load minimum weight 60,000 lb., and

40½c. car-load minimum weight 30,000 lb. Shippers propose the establishment of a through rate of 27½c., car-load minimum weight 30,000 lb.—Docket No. 403-K.

Sand.—Shippers propose a reduction in the rate on moulding sand¹, from Merrimac, Wis., to Detroit, Mich., from \$5.20 to \$3.00 per net ton.—Docket No. 981-A.

Southern Freight Assn.

Lime.—Shippers propose the establishment of rates on lime from Sherwood, Tenn., to Hopewell, Va., of \$4.20, car-load minimum weight 30,000 lb., and of \$3.36, car-load minimum weight 50,000 lb., per net ton, to apply in lieu of the Petersburg, Va., combination. These proposed rates are the same as currently in effect to Petersburg, Va.—Docket No. 56,773.

Talc.—It is proposed to reduce the rate on roofing talc, car-load minimum weight 60,000 lb., from Chester, Vt., to Port Wentworth and Savannah, Ga., from 82c. to 36c. per 100 lb.

This rate is suggested by the carrier.—Docket No. 56,691.

¹ The car-load minimum weight will be 90 per cent. of the marked capacity of the car except that where car is loaded to full cubical or visible capacity, the actual weight will apply.

Reorganization Plans of Asbestos Corp. Complete

The reorganization plan of the Asbestos Corp. of Montreal, Canada, provides for the substitution of a modified form of income bonds for first-mortgage bonds on which interest is in arrears one and a half years, and new stock for general mortgage bonds on which interest is in arrears two years.

First-mortgage bonds will receive an equal amount of income bonds plus one share of new common for each \$100 principal amount of bonds. General mortgage bonds will receive one and a half shares of new common for each \$100 principal amount; each ten shares of present preferred, one and a half shares of new common and each 50 shares of present common, one and a quarter shares of new common.

Management and control of the company is to be vested in five voting trustees during life of the income bonds.

Book Review

A BARITE DEPOSIT IN HOT SPRING COUNTY, ARKANSAS. By Bryan Parks and George C. Branner. 52 pp. Published by the Arkansas Geological Survey, Little Rock, Ark. Price \$1.00 postpaid. Discusses the location, quality and origin of a barite deposit and describes its prospects, including an estimate of the possible tonnage. Contains detailed maps. Mimeographed on heavy paper and bound in durable covers.

Financial News

The information contained in these financial pages is given with the understanding that any statement on the part of this magazine or any of its staff, as to the responsibility or standing of any person, firm or corporation, or as to the value of any property or securities is a mere expression of opinion, given as a matter of service to the readers of PIT AND QUARRY, for which no responsibility in any way is to attach to this magazine or to any of its staff.

1931 Operations Result in Loss for Penn-Dixie

Report of Pennsylvania-Dixie Cement Corp. and subsidiaries for year ended December 31, 1931, shows, after provision for taxes, interest and a charge of \$1,393,129 for depreciation and depletion, a net loss of \$1,358,506. This compares with net profit of \$587,461, equal to \$4.32 a share (par \$100) on 135,888 shares of preferred 7-per cent. stock on which no dividends have been paid since September 15, 1929.

At the close of December, the company had current assets of \$5,902,582, and current liabilities of \$445,069, a ratio of 13 to 1. Net current assets of \$5,457,513 represented a reduction of \$661,708 from a year ago, occasioned chiefly by bond purchases and by a write-down of inventory value of cloth sacks. Inventories were \$770,470 below 1930. Cash and short-term securities aggregated \$3,463,985, a new high record.

Outstanding bonds totaled \$10,123,000, or \$619,500 less than a year ago. After providing for 1931 sinking fund requirements there remained in the treasury \$706,000 of bonds purchased in the open market in addition to \$1,515,000 of bonds previously drawn down against expenditures for capital improvements, or a total of \$2,221,000 principal amount of bonds.

During the year 4,900 shares of preferred stock held as treasury stock was retired. This plan included shares purchased under a plan for resale to employees, which plan is now deferred.

Consolidated income account for year 1931 compares as follows:

	1931	1930
Net sales	\$6,117,674	\$8,625,170
Exp. (less other inc.)	5,455,038	5,884,560
Balance	\$ 662,636	\$2,740,610
Depr. & depl.	1,393,129	1,379,289
Interest	628,013	669,376
Fed. taxes		104,484
Net loss	\$1,358,506	†\$587,461
Pfd. divs.		
Com. divs.		
Deficit	\$1,358,506	*\$587,461
P & L surp.	1,551,306	2,598,061
* Surplus. † Profit.		

Consolidated balance sheet as of December 31, 1931, compares as follows:

	1931	Assets 1930
*Land, bldgs., mach. & eq.	\$23,282,388	\$24,352,433
Cash	3,081,985	3,323,803
Short-term sec.	382,000	102,000
Notes & accounts rec.	389,959	466,285
Inventories	2,048,638	2,819,108
Misc. invest.	92,636	346,445
Ins. fund		186,409
Def. charges	18,290	24,606
Total	\$29,295,896	\$31,621,089
Pfd. stock	\$13,098,800	\$13,588,800
†Com. stock	4,000,000	4,000,000
Gold bonds	10,123,000	10,742,500
Accounts pay.	150,013	119,478
Accr'd taxes, interest, etc.	268,413	293,537
Fed'l tax res.	26,644	178,959
Other reserves	77,720	99,754
Surplus	1,551,306	2,598,061
Total	\$29,295,896	\$31,621,089

*After depreciation and depletion. † Represented by 400,000 no-par shares.

Surplus account follows: Balance of capital surplus January 1, 1931, \$2,055,885; add: Profit on purchase of bonds under par, \$267,417; excess of par value over cost of preferred stock retired, \$293,781; total, \$2,617,083; deduct: Amount of reserve provided in respect of cloth bags in inventories, \$249,447; deficiency in earned surplus, \$816,330, leaving surplus December 31, 1931, \$1,551,306.

The company's shipments for 1931 showed a percentage reduction of less than half of that recorded for the country as a whole, Blaine S. Smith, president, told stockholders. According to Department of Commerce, cement consumption in the United States last year was 20 per cent. less than the year before and 28 per cent. below the peak year of 1928.

"General business conditions," Mr. Smith said, "coupled with the large overcapacity in the industry and reduced demand, brought selling prices to the lowest levels in over 15 years. Our average price realized for the year was more than 30 c. a bbl. less than for the year before and more than 60 c. a bbl. less than in 1926.

"Mill operations were curtailed as compared with the year before, not only on account of reduced shipments,

but in order to bring our stocks on hand down to the lowest practicable level. At the end of the year these stocks were 500,000 bbls. less than at the previous year-end. Notwithstanding these greatly curtailed operations, our bin-cost of cement produced was less than in any previous year. Increased efficiency is noted in all of our operations.

"It was necessary to reduce salaries and wages substantially during the year, the average being about 20 per cent. Other economies have been effected in all departments. General, administrative and selling expense for the year was about \$300,000 less than the year before, \$400,000 less than in 1929 and \$550,000 less than 1928."

Economies May Aid Firm to Show Profit in 1932

The annual meeting of the stockholders of the Petoskey Portland Cement Co. was held at the company offices at Petoskey, Mich., recently with J. B. John, president, presiding. Over 140,000 shares of stock were represented in person or by proxy, out of a total of slightly more than 190,000 shares outstanding.

The financial statement of the company showed a loss for the year of \$18,014.24 before depreciation and with the depreciation figure of \$235,305.28 added showed a net loss of \$253,319.52. The full amount of depreciation on the plant was taken, Mr. John explained, as allowed by the government, this being generally conceded as the wisest procedure. Plant valuation as of December 31 showed a book value of \$3,261,206.12.

Shipments for 1931 were only about 8 per cent. less than for 1930. Price reductions on cement, however, were responsible for a loss in gross income of more than \$500,000 over the previous year. The payroll for the year was reduced by about \$210,000, due mainly to abandonment of new con-

(Continued on page 65)

CURRENT DIVIDENDS

COMPANY	CLASS OF STOCK	DIVIDEND RATE	HOLDERS OF RECORD	PAYABLE	COMPANY	CLASS OF STOCK	DIVIDEND RATE	HOLDERS OF RECORD	PAYABLE
Alpha Portland Cement	Common	\$0.25 qr.	Jan. 2	Jan. 25	Lehigh Portland Cement	Preferred	\$1.75 qr.	Dec. 14	Jan. 2
Arundel Corp.	Common	\$0.75 qr.	Dec. 21	Jan. 2	Missouri Portland Cement	Common	\$0.25 qr.	Jan. 21	Jan. 30
Boston Sand & Gravel	Preferred	\$0.87 1/2 qr.	Dec. 22	Jan. 2	National Gypsum Co.	Preferred	\$1.75 qr.	Dec. 15	Jan. 2
Boston Sand & Gravel	Common	\$0.15 qr.	Dec. 22	Jan. 2	New York Trap Rock	Preferred	\$1.75 qr.	Dec. 21	Jan. 2
Calaveras Cement	Preferred	\$1.75 qr.	Dec. 31	Jan. 15	Owens-Illinois Glass	Common	\$1.50 qr.	Jan. 30	Feb. 15
Cleveland Quarries Co.	Common	\$0.25 qr.	Feb. 15	Mar. 1	Owens-Illinois Glass	Preferred	\$1.75 qr.	Mar. 16	Apr. 1
Dolese & Shepard	Common	\$1.00 qr.	Dec. 21	Jan. 2	Pacific Portland Cement	Preferred	\$1.62 1/2 qr.	Dec. 31	Jan. 5
Fitzsimons & Connell	Common	\$0.50 qr.	Feb. 19	Mar. 1	Pennsylvania Glass Sand	Preferred	\$1.75 qr.	Dec. 16	Jan. 1
Great Lakes Dredge & Dock	Common	\$0.25 qr.	Feb. 5	Feb. 15	Riverside Portland Cement	Preferred	\$1.50 qr.	Jan. 15	Feb. 1
Ideal Cement	Common	\$0.50 qr.	Dec. 15	Jan. 2	Smith Agricultural Chemical	Preferred	\$1.50 qr.	Jan. 21	Feb. 1
Johns-Manville	Common	\$1.75 qr.	Dec. 26	Jan. 16	Standard Pav. & Materials	Preferred	\$1.75 qr.	Jan. 30	Feb. 15
Kentucky Rock Asphalt	Common	\$1.75 qr.	Dec. 10	Jan. 2	Superior Portland Cement	Class A	\$0.27 1/4 M	Feb. 23	Mar. 1

Review of Foreign Practice

World Cement Capacity 100,000,000 Metric Tons

According to the most recent figures available, the combined capacity of all cement plants in the world must be about 100,000,000 metric tons; the actual production in 1930, however, was probably between 60,000,000 and 70,000,000 tons. A plant with a yearly capacity of 100,000 tons requires around 160,000 tons of raw materials, of which about 120,000 tons are the calcareous ingredient and 40,000 tons the argillaceous; these figures apply in the strictest sense to the dry process. On the basis of 60,000,000 tons as the world's annual cement production, therefore, some 28,800,000 tons of calcareous and 24,000,000 tons of argillaceous raw materials would be used.

In Germany the raw materials vary with the district; in the North German district, where the earliest German cement plants were built, the usual material is soft chalk, the material also used in the first cement works in England. The mills of upper Silesia use a hard chalk, which is also the customary material in those of the Hannover-Westfalia region, with a few exceptions; the plants at Hoxter and Vorwohle operate with Triassic limestone. The plants in middle Germany and Thuringia and at Rudersdorf near Berlin also use Triassic limestone. The plants of the upper Rhine region use limestone of Tertiary formation, while the plants at Heidelberg and Karlstadt get their material from the Triassic formation. The other south German plants, with the exception of Marienstein, which uses Tertiary limestone, take their stone from the Jura formation. Germany's annual cement production is around 7,000,000 metric tons; the raw materials used are distributed approximately as follows: hard chalk, 35 per cent.; Triassic limestone, 31 per cent.; soft chalk, 15 per cent.; Tertiary limestone, 10 per cent., and Jurassic, 9 per cent.

In Great Britain chalk was for a long time the only calcareous material used, being obtained from the deposits along Thames and Medway Rivers; they are used in connection with alluvial clay in making cement. The plants in the Rugby and South Wales district use limestone and shale from the Liassic formation; in Cambridgeshire there is a deposit of argillaceous chalk-marl, with a chemical composition very close to that of cement, like the deposits in the Lehigh Valley, at Novorossisk on the Black Sea, in Belgium, in Dalmatia and even in Germany (Paderborn). In central and northern England the predominant materials again are chalk and a clay

low in organic matter. In Northamptonshire oolitic limestone and Liassic clay are used. In the vicinity of Edinburgh there is a deposit of comparatively pure crystalline limestone that is mixed in manufacture with stones with lower calcium-carbonate content. In other places in Scotland blast-furnace slag and limestone are also used. In the neighborhood of Larne in Ireland a hard chalk is used.

In France the best raw materials are chalk and clay, and the first plant in the country, founded in 1848 at Boulogne, still operates with chalk. In Belgium, on the other hand, the customary material is a limestone with a comparatively low calcium-carbonate content.

In Spain there are large raw-material deposits of two separate groups; on the one hand, a loam with 72 per cent. calcium carbonate; on the other an amorphous calcareous material occurring as a fine powder with 97 per cent. calcium-carbonate content. Spain also uses some deposits of hard crystalline limestone, some of low and some of high calcium-carbonate content; the latter sometimes must be used with sandstone or clay to attain the needed proportions of silica and alumina. Also, trass, volcanic ash and the like are used in Spain for producing a pozzuolanic cement.

In Denmark the materials are soft chalk with 97 per cent. calcium carbonate, and an alluvial clay.

In Dalmatia there are large sea-coast deposits of marl which frequently contain the correct composition for the manufacture of cement; the natural mix consists of roughly 75 per cent. calcium carbonate and over 20 per cent. clay substance. Dalmatia also has large deposits of limestone which often are high in silica content.

In the United States a large part of the cement is made from the argillaceous limestone of the Lehigh Valley; as this is ordinarily high in clay substance, 10 to 20 per cent. of high-calcium limestone is added. In certain places such materials as mussel and oyster shells and marl are employed. Canada uses both high- and low-calcium limestone and marl. Mexico has available extensive deposits of crystalline limestone and clay.

Part of the materials in Australia consists of limestone and sea shells, the latter consisting almost entirely of silica and alumina. Limestone is found in large deposits in different parts of the country, but often too impure to be used for cement.

Limestone deposits of South Africa vary considerably. Some consist of secondary clods of dense limestone, below which is a mixture of different minerals, some fallen to powder. In other places there are limestone de-

posits inclosing hard and massive tufts. The chemical make-up of calcareous and argillaceous materials is exceedingly variable.

In India the deposits are mainly hard limestone, many of correct composition for the manufacture of cement. There are also large clay deposits, although they are little needed and little used.

Japanese cements are predominantly made from hard limestone. The argillaceous materials are clay and shale. Industrial wastes are also used both as calcareous and argillaceous materials.—Dr. C. R. Platzmann in *Zement* 21:47-49, Jan. 28, 1932.

Value of Fluorspar in Production of Cement

France possesses many deposits of fluorspar with high contents of calcium fluoride, some of them being much richer than deposits of other countries in general. About 50,000 tons is excavated annually, of which a large part is exported to the United States. The utilization of the material at present is about 80 per cent. in the metallurgical industries, 10 per cent. in the ceramic and glass industries, and 10 per cent. in the chemical industries. These industries require an ore with from 85 to 96 or 97 per cent. of CaF₂. The use of fluorspar in metallurgy has developed greatly in the course of the last few years and, on this account, several new deposits have been opened, particularly in the department of Var and the Massif Central.

Fluorspar has a comparatively low melting point, which makes it an extremely useful flux, either in the glass industry, where it lowers the melting-point of the glass and makes it more supple, or in the iron-and-steel industry, where it effects a very appreciable lowering of temperature required for smelting. For some time the cement industry, too, has been interested in the use of fluorspar. Only modest experiments have been made in its actual employment, and with the special object of lowering the point of vitrification in rotary kilns. In general, the normal temperature of these kilns is around 1,400 deg. C., and the use of 6 per cent. of fluorspar would make it possible to lower this temperature to less than 900 deg.—a quite considerable difference, with a great economy of fuel, a possibility of using waste heat in connection with gas producers, and a certain lowering of power costs. Also, cements with fluorspar never form rings in rotary kilns, which lengthens the life of refractory linings and saves time by reducing to the minimum the stops required.—Adolphe Janin in *Le Ciment* 37:32, Jan., 1932.

Recent Patents

Blasting

Blasting cap. California Cap Co., Oakland, assignee of John A. Hammond, Albany, Cal. Canadian 319,247.

Bore-hole loading apparatus. Orkla Grube-Aktiebolag, assignee of Otto Frederik Borchdrevink, Lokken Verk near Trondkjen, Norway. Canadian 319,305.

Cement and Concrete

Manufacture and casting of cement products. W. Gartner. British 363,637.

Mortar concrete and the like. F. E. Marechal. British 363,746.

Manufacture of articles from hydraulic-cement material. U. Issmann. British 363,873.

Reinforced-concrete hollow walls, floors, roofs and the like. M. N. Ridley. British 364,618.

Process and apparatus for the manufacture of articles of reinforced concrete. E. Freyssinet and J. Seailles. British 364,621.

Crushing and Grinding

Coal-crushing machine. "B & L" Powdered Fuel, Ltd., London, assignee of Henry Martinez and Robert Hutchinson Kirk, Newcastle-upon-Tyne, England. Canadian 319,040.

Crushing machines. Greenwood & Batley, Ltd., J. C. M. Maclagan and A. Pendlebury. British 364,169.

Pulverizers. A. W. Bennis. British 364,193.

Pulverizing mills. International Combustion, Ltd. British 364,213 and 364,526.

Gyratory cone crushers. Nordberg Manufacturing Co. British 364,651.

Pulverizers for coal or other material. P. W. Griffin. British 364,954.

Grinding mill. F. L. Smidth & Co., New York, N. Y., assignee of Niggo Sahmel, Forest Hills, N. Y. Canadian 319,316.

Device for sifting materials in impact pulverizers. Paul Anger, Kiel, Germany. Canadian 319,373.

Drilling

Rifle Head for rock drills. Robert J. Hopland, Seattle, Wash., administrator of estate of Raymond R. Hopland. Canadian 318,934.

Feeding - devices for percussive tools. Ingersoll-Rand Co. British 363,793.

Drills for rock, marble and the like. F. Krupp Akt.-Ges. British 363,913 and 363,982.

Dust-confining devices for rock drills. Newport Abercarn Black Vein Steam Coal Co., Ltd., and F. A. Hale. British 364,307.

Rotary-drill bits. F. Krupp Akt.-Ges. British 364,460.

Hammer rock-drills. G. Bergstrom. British 364,487.

Non-return valves for compressors, hammer drills, internal-combustion en-

gines, and other apparatus. G. H. Coy. British 364,703.

Manufacture of hollow drill steel and like hollow bars. Fagersta Bruks Aktiebolag. British 365,029.

Drying

Drying, heating, cooling and so forth of granular, powdery and like materials. Stettiner Chamotte-Fabrik Akt.-Ges. vorinals Didier. British 363,701.

Drying kilns. A. E. White (B. F. Sturtevant Co.). British 364,560.

Drying of road-making aggregates or other broken or granular material. J. F. Wake. British 364,762.

Excavating

Friction-type dipper trip. George G. Morin, Holyoke, Mass. Canadian 319,201.

Suction-dredge cutter. American Manganese Steel Co., Chicago, assignee of Arthur W. Daniels, Chicago Heights, Ill. Canadian 319,435.

Tractor truck for power shovels. Ohio Power Shovel Co., assignee of Homer B. Haines, Lima, Ohio. Canadian 319,512.

Kilns

Rotary kiln. Fellner & Ziegler Akt.-Ges. and B. Young. British 363,900.

Furnace for sintering, roasting and firing. Vereinigte Stahlwerke Akt.-Ges. British 364,698.

Rotary kiln. F. L. Smidth & Co., New York, N. Y., assignee of Louis Steffen Peterson, Elizabeth, N. J. Canadian 319,315.

Feeding apparatus for rotary kilns. Adolphe Busch, Antwerp, Belgium. Canadian 319,567.

Lime and Magnesia

Process for the decalcification of mixed calcium and magnesium carbonate materials. C. Arnold (Dolomite, Inc.). British 363,871.

Process of separating and preparing lime and magnesia. Dolomite, Inc., Maple Grove, assignee of Harvey N. Barrett, Tiffin, Ohio. Canadian 319,484.

Lime-slaking machine. Edwin Joseph Shaut, inventor, Harry R. Baker and Philip S. Dickinson, Los Angeles, Cal. Canadian 319,542.

Material-Handling

Portable self-filling loading-shovel. G. Robson and F. Marshall. British 363,726.

Belt conveyors. W. D. Wright and M. F. Higgins. British 363,964.

Conveying, loading or like machines. British Jeffrey-Diamond, Ltd. (Jeffrey Manufacturing Co.). British 364,118.

Belt conveyors. T. G. Nyborg. British 364,294.

Jigging conveyors and the like. S. Baillie. British 364,680.

Conveyors. J. Cookson. British 364,735.

Conveyors. Preparation Industrielle des Combustibles. British 364,953.

Conveyors. R. Devrin. British 364,964.

Mining

Winding-gear for deep shafts. P. Mommertz and F. Lenze. British 364,235.

Devices for measuring the load carried by pit-props. S. M. Dixon. British 364,686.

Foot attachment for pit-props or steel arches employed as mining roof supports. Darlington Rolling Mills Co., Ltd., and T. Hensforth. British 364,814.

Mining apparatus. Sullivan Machinery Co., Chicago, Ill., assignee of Charles F. Osgood, Claremont, N. H. Canadian 319,702.

Sacking

Valve bags. J. W. Winskill. British 364,590.

Paper bags and the like. R. L. Marston. British 364,979.

Valve bags. W. A. Merrick. British 364,987.

Valve sack and closure. Rene Jarrier, Saint-Quentin (Aisne), France. Canadian 319,591.

Screening and Separating

Screening plants. A. Sharp and H. A. Ashton. British 363,994.

Centrifugal dust separators and collectors. H. Van Tongeren. British 364,449.

Rotary screens. Baron (D. M. P. Carleton) Dorchester and S. M. Wilmot & Co., Ltd. British 364,774.

Method of preparing aggregates. George Miller Thompson, Caledonia, Ont. Canadian 319,616.

Unclassified

Manufacture of tarred macadam and the like. J. F. Wake. British 363,655.

Process for manufacturing barium sulphate of definite granule size. Sachtleben Akt.-Ges. für Bergbau und Chemische Industrie. British 363,936.

Vessels having equipment for transferring or discharging bulk cargoes. J. Donaldson, Jr. British 363,957.

Process for working-up cryolite. L. Mellersch-Jackson (F. Krupp Grusonwerk Akt.-Ges.). British 364,890.

PIT AND QUARRY will furnish, at its actual cost, a copy of any patent cited here. A charge of ten cents per copy is made by the U. S. Patent Office, Washington, D. C., and readers may procure a copy directly by addressing the Commissioner of Patents, with payment for copies requested. Postage stamps are not accepted by the Patent Office. We will endeavor to obtain copies of foreign patents for our readers but we cannot give assurance in every case for the reason that copies of such patents are not printed for distribution as liberally as are the American copies, nor is there a fixed charge per copy.

Manufacturers' Publications

Each publication listed below contains information of interest to non-metallic mineral producers. Readers may obtain, without charge—except where a price may be stated—and without obligation, copies of any of these publications by writing directly to the manufacturers who publish them. Please mention PIT AND QUARRY when writing.

Buckets

Williams Type "MF" Bucket. 4 p. (Wellman Engineering Co., Cleveland, O.) Describes and illustrates a multiple-rope clam-shell bucket in rated capacities of ½ to 2 cu. yd.

Concrete Plants

Butler Commercial Concrete Plants. 16 p. (Bull. No. 180. Butler Bin Co., Waukesha, Wis.) Describes and illustrates units and complete plants for the production of central-proportioned concrete mixed by trucks enroute to the job.

Crushers

Universal Crushers. 24 p. (Cat. No. 130A. Universal Crusher Co., Cedar Rapids, Ia.) Describes and illustrates a complete line of crushing equipment for any size operation. Also lists elevators, screens, conveyors and bins.

Dredging Plants

Hydraulic Dredging Plants for Sand and Gravel Production. 28 p. (Bull. 144. Morris Machine Works, Baldwinville, N. Y.) A new booklet describing and illustrating modern dredging methods. Several plants employing dredge pumps and equipment made by this company are shown. A chapter on the selection of dredging pumps and tables of capacities and friction-losses are especially valuable to the operator.

Dust Collectors

Norblo Continuous Operating Air Filters. 4 p. (Bull. 500-1. Northern Blower Co., Cleveland, O.) Describes and illustrates recent changes and improvements in this company's multiple cloth-bag dust filter.

Motors

Type T Motors for Direct Current. 5 p. (Bull. 211. The Reliance Electric & Manufacturing Co., Cleveland, O.) Describes and illustrates a series of large heavy-duty, direct-current motors in sizes from 100 hp. at 200 r.p.m., to 350 hp. at 850 r.p.m. Includes details of construction, cross-sectional drawings and table of ratings.

Plant Equipment

Telsmith Mining, Quarry and Gravel Pit Machinery. 32 p. (Bull. No. 266. H. Smith Engineering Works, Milwaukee, Wis.) A new publication covering this company's complete line of primary breakers, jaw crushers, reduction crushers, screens, washing equipment, vibrators, etc. Illustrations show the details of construction of the various units as well as typical applications in existing plants.

Scales, Automatic

How to Save with Bulk Cement. 12 p. (Bull. 9131. Richardson Scale Co., Clifton, N. J.) Describes and illustrates the economy of purchasing and using bulk cement for concrete-making by the employment of an automatic weighing scale for the accurate proportioning of cement.

Scrapers

How to Convert Your Dragline or Crane Into a Long Range Machine. 16 p. (Sauerma Bros., Inc., Chicago, Ill.) Describes and illustrates the use of long-range scrapers with boom machines. Drawings point out the ease and applicability by which these combinations can solve almost any job of excavating, stripping, reclaiming, etc.

Shovels

A.C.-D.C. Facts. 16 p. (The Marion Steam Shovel Co., Marion, O.) A non-technical booklet tracing the progress of electric-shovel development and pointing out the various factors governing the choice of primary power units. Points out the factors favoring direct-current motors as against alternating-current units for shovel operation.

Used Equipment

Used Machinery for Crushing, Pulverizing, Filtering and Drying. 6 p. (Bull. 14. Consolidated Products Co., Inc., New York, N. Y.) Describes and illustrates a complete stock of crushing, pulverizing, drying and filtering equipment, some new items and a large selection of used machinery.

Unclassified

Trackson Automatic Coupler. (Trackson Co., Milwaukee, Wis.) Describes and illustrates an automatic coupler for use with tractors, trucks, trailers and other industrial vehicles, allowing one-man control in coupling or releasing rolling stock.

Material-Handling Equipment. 6 p. (Iowa Manufacturing Co., Cedar Rapids, Ia.) A circular describing and illustrating crushing, screening, washing, conveying equipment and oil-mixing units. The company's new heavy-duty reduction crusher is featured.

Rockford O-C Industrial Clutches. 4 p. (Rockford Drilling Machine Co., Rockford, Ill.) Describes and illustrates "over-center" or toggle-type clutches for cranes, excavators, concrete mixers, tractors, pumping units, compressors, etc.

Appoints Representative in North-Central States

The Allen Sherman Hoff Co. has appointed the Kent Ervin Engineering Co., Minneapolis, Minn., as representative for the sale of its products in Minnesota, North Dakota, South Dakota and northwestern Wisconsin. They will handle the sale of the Hydrojet system of ash removal, the Hydrovac system of soot and siftings handling, Hydroséal ash and dredge pumps, cast-iron ash hoppers and water collecting ash gates and cast-iron coal bunkers.

New Incorporations

WILLIAMS & SCHNEIDER STONE CO., Springfield, Mo. Capital stock \$45,000. J. Sam Williams, R. F. D. 80, and others.

ROCKY DALE QUARRIES CORP., Roanoke, Va. Capital stock \$50,000. C. E. Hunter, Mountain Trust Co. Bldg., and others.

FLORIDA MARBLE & GRANITE CO., INC., Orlando, Fla. J. G. Holton and F. Madsen.

SAN ANTONIO ROCK PRODUCTS CO., Upland, Cal. \$25,000. J. H. Briscoe and W. R. Cassidy of Pomona; W. R. Brooks of Long Beach.

BATTLE CREEK SAND & GRAVEL CO., Battle Creek, Mich. 1,500 shares \$10 preferred stock. Carl A. Sandberg, pres., R.F.D. No. 1, Box 43; Lillian L. Huyck, v-pres., Eugene V. Huyck, sec.

CLE ELUM SAND & GRAVEL CO., INC., Seattle, Wash. Capital stock \$25,000. M. M. Hertick, Frances S. Malloy and E. E. Flood.

THE BELTON SAND & GRAVEL CO., Belton, Tex. Burrell McNery, Dallas, and others.

AUBURN SAND & GRAVEL CO., Worcester, Mass. 500 shares n.p.v. Samuel J. Kattor, 5 Hyannis Place, pres.-treas.; Mary and Joseph S. Kattor.

LANEE SAND & GRAVEL CO., Eugene, Ore. Capital \$75,000.

THE MALVERN GRAVEL CO., Wilmington, Del. Capital \$30,000.

THE HIGHWAY SAND & GRAVEL CORP., 1449 Broadway, New York, N. Y., \$20,000 preferred; 800 shares common. J. Atz.

THE CANADA CHALK CO., LTD., Toronto, Ont., Can. 40,000 n.p.v. William Yerex and Arthur G. Cropp. To manufacture limestone and gypsum.

NATIONAL GRANITE WORKS, LTD., Montreal, Que., Can. Capital \$100,000; Adrian Knatchbull-Hugessen, Hamilton L. Smith and Edmond J. Eberts. To produce stone, marble, granite, gravel, sand, lime, etc.

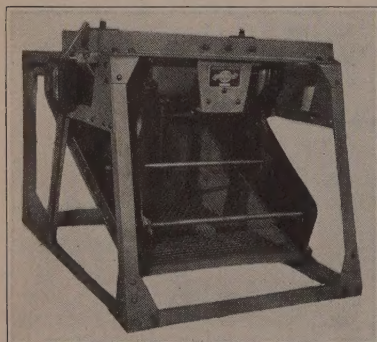
New Machinery and Supplies

Electrically-Vibrated Screen Simply Designed

The improved Mitchell electric vibrating screen manufactured by the C. W. Hunt Co., division of Gifford-Wood Co., Hudson, N. Y., has received much favorable comment from engineers due to its simplicity and efficiency of operation.

This screen shown in the accompanying illustration consists essentially of four main parts—the vibrator, vibrating plates, screen cloth and supporting structure. The entire design is well thought out and extremely simple.

The vibrating unit is responsible for the high efficiency of the screen. It is compact, well-designed, built of high-grade materials and consists of a special built-in motor, the shaft of which extends the full length of the housing and runs on ball bearings. On each end of the shaft is a ball cage, one steel ball being placed in each



Single-deck model of the electric vibrating screen.

cage. These balls are placed diametrically opposite at 180 deg. and run in hardened steel races. This eccentric loading is transmitted to the housing so that the entire unit vibrates. The motor runs at 3600 r.p.m. causing that many vibrations per minute. The whole unit is totally enclosed and is, therefore, dust-proof, oil-proof and water-proof.

The principle of vibration is unbalanced centrifugal force harnessed to the screen in such a manner that practically all of the vibrations are transmitted to the screen cloth. There is practically no loss of vibration as this is easily proven by the fact that a pencil will stand on end on the supporting frame while the screen is running. This also eliminates the possibility of a weakening effect on building members which may be used to support the screen as no vibrations are transmitted to them.

Although the amplitude of vibration which is of a circular character is very small, in fact, less than $\frac{1}{16}$ -in., the

force applied to vibrate the screen is large, approximately 2600 lb. in a standard screen. The horse-power of the motor used to create this force is only $\frac{3}{4}$.

In actual test this screen has proven to have no dead spots on the screen cloth. Furthermore, the intensity of the vibration is practically uniform over the entire surface of the screen cloth. Efficient screening is thereby obtained on every square inch of the screen surface.

Another factor which is of importance is the few working parts of the screen. Maintenance is naturally very low and the chance for trouble and, incidentally, interrupted production is eliminated to a very great extent.

The standard screen is 3 ft. wide by 5 ft. long but it can also be furnished in the 6, 7 and 8 ft. lengths. A double-deck screen can also be furnished.

TZ Reduction Crusher Has Many Improvements

Major contracts closed within the past year by the Traylor Engineering & Manufacturing Co. in the pit-and-quarry field included a crushing plant for the Newark Plaster Co., a cement plant for Corporacion Cementera Argentina, two 60-in. by 84-in. Bulldog jaw crushers for the U. S. S. R. Government, and a complete 7,500-ton crushing plant for the Hudson River Stone Corp. The company also enjoyed good business with its new Type TZ reduction crusher, and a rather unusual number of conversions of old-type gyratories, utilizing the bell-head and concaves of the Type TZ machine.

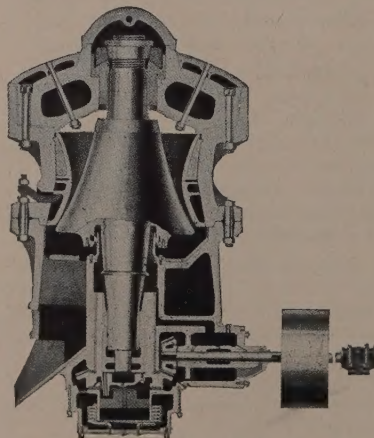


Fig. 1. Cross-section of the improved crusher.

The TZ was greatly improved during the year, so that it is now claimed to be the outstanding reduction machine. The crushing principle is said to be entirely new and is based on the

development of a gyratory crusher's natural tendency to free itself from elements which contribute to packing the discharge area. The development of the design, as well as the operation of the machine, are said to prove that only by the use of *both* curved heads and convex concaves may choking be eliminated. (See Fig. 1.)

When the combination of the two are used, as Traylor has designed the parts, these objects are reported to be attained:—(1) Choking or packing are absolutely dispensed with; (2) Power per ton is halved, that is, twice

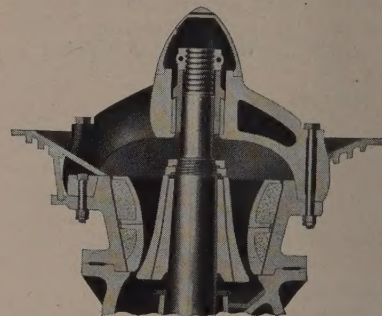


Fig. 2. Cross-section of an old style gyratory crusher showing how it appears when fitted with bell head and concaves.

the former capacity is obtained without any increase of power consumed. This is due to elimination of the waste power consumed when the discharge is choked. The practical advantage is that operators may double their output of fines or reduce overhead by producing their required output in one machine instead of two, which they may have been using. (3) Notwithstanding the doubling of capacity, the product size may be reduced from one-fifth to four-tenths of the previous minimum setting. (4) Undesirable waste fines are eliminated, because little of the stone is crushed beyond the stage necessary to yield the size of product desired. The percentage of oversize too, is measurably reduced. (5) Larger than usual receiving openings are provided, and a considerably greater ratio of reduction is made possible. (6) The life of the wearing parts is at least doubled in even the severest duty, and under favorable conditions may be trebled or quadrupled. This greatly reduces crusher maintenance. (7) The Traylor bell head and concaves may be built into any gyratory, regardless of make, size, type or age, at a cost which compares most favorably with that of replacement of the old style parts displaced.

The easy adaptability of the head and concave design may be noted from an examination of the illustration shown in Fig. 2. Hundreds of old type gyratories of five different makes and all sizes have been converted into highly-effective reduction crushers by fitting

them with the new bell head and concaves. In the aggregate, these crushers are saving vast sums of money for operators in nearly every state in the Union, in many parts of Canada, and in some foreign countries.

Bulletin 1110 gives interesting details, and a new booklet just off the press treats of details of design. They may be had by writing the Traylor Engineering & Manufacturing Co., Allentown, Pa.

The description of the Traylor crusher published in the January 13, 1932, issue of PIT AND QUARRY was incorrect in that it did not cover the improvement herein described, but related to the model which the new TZ machine has replaced. The present description, therefore, covers the most recent type of Traylor TZ crusher.

Unit Type Heavy-Duty Push-Button Stations

A new line of push-button stations (Type CR-2940), designed for general industrial applications, has been announced by the General Electric Co.

The stations included in the line are divided into three general classes: those which make momentary contact, those which maintain the contact, and a combination of both. With a momentary contact the circuit is completed or interrupted only as long as the operator's finger depresses the button. This is required when the station is used with a controller that must provide under-voltage protection. A maintaining contact holds the circuit open or closed as does an ordinary knife switch.

The devices consist of one or more of the following units inclosed in a case: 1. Push button (momentary contact), 2. Selector switch (maintaining contact), and 3. Indicating-lamp receptacle. Any combination not exceeding five of these units is available in the wall-mounted stations. The same case houses the push button, selector switch or lamp receptacle.

The momentary-contact, push-button unit provides both a normally-open and a normally-closed circuit. Heavy, double-break contacts are employed and a rolling contact is obtained on both normally-open and normally-closed positions. Allowance for ample creepage distances from live parts to

ground make this device suitable for operation on 600-volt circuits.

The maintaining-contact selector switches are available for operation as single-pole, single-throw; single-pole, double-throw; or double-pole, single-throw knife switches.

In the stations employing indicating lamps, 18-v. lamps with color caps are used. For higher voltage a separately mounted resistor is used in series with the lamp except in cases where a station requires a certain voltage, in which case the resistor may be included in the station.

The resistor consists of one or more resistor units and a terminal board mounted in a standard push-button enclosing case. Knockouts in the case provide for connections between the push-button station and the resistor. Ventilation is obtained through the holes in the cover which are covered by wire mesh. Spacers at the back of the case protect the wall or panel from the heat of the resistors.

The wall-mounted stations have a two-piece enclosing case of heavy punched steel with black japan finish. Double conduit knockouts permit the use of either of two conduit sizes at the top and bottom. A knockout is also provided in the back so that the station is suitable for mounting on the front of a panel. With the cover removed the units are accessible from both sides of the unit which permits the connection of all necessary control wires. Curved nameplates on the cover embrace and clearly indicate the button designated. A red nameplate is used for the "stop" button.

A locking bar may be provided where desired with means for attaching a padlock so that the "stop" button may be locked open to prevent starting.

The units are mounted on a terminal board which is rigidly supported on the back of the panel. Terminals are accessible for easy wiring after the station is mounted.

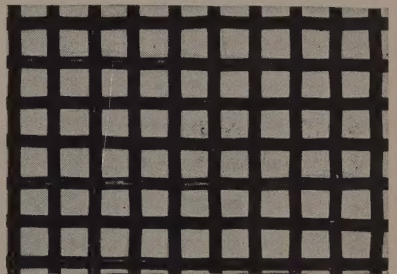
Spring-Steel Wire Cloth Gives Excellent Results

The National Wire Cloth Co. of St. Paul, Minn., maker of National Spring-Steel wire cloth, has developed

a screen cloth of high-grade spring steel which is reported to be giving excellent results in a number of sand-and-gravel, cement, lime and crushed-stone plants, replacing perforated plate in revolving and conical jackets as well as on vibrating and shaking screens.

This new cloth may be had in sizes ranging from 1/16 in. to 6 in. mesh, the spring rods used in forming the cloth being as heavy as 1 in. in diameter where abrasive and rough screening is necessary. The accompanying illustration shows a close-up view of the spring-steel cloth and portrays its rugged, accurate construction.

The National Wire Cloth Co. has all sizes on hand for immediate shipment, large stocks being constantly maintained to insure rapid, prompt service. Not only has this screen cloth found favor throughout the United States,



A section of the spring-steel screen.

the company reports, but it is being used in Canadian, Mexican and Alaskan plants as well.

A sample of the spring-steel screen will be sent to any user of screening equipment upon request to the company.

Blouch Heads Lenawee Sand & Gravel Company

At the annual meeting of the Lenawee Sand & Gravel Co. of Tecumseh, Mich., held January 20, the following officers were elected: President, F. J. Blouch; vice-president, William Amstead; secretary and treasurer, Frank Hoffman.

Financial News

(Continued from page 60)

struction, and this plan will be continued during 1932, it was stated. A salary reduction of 10 per cent. placed in effect January 1 will represent another saving for this year.

The general status of the Petoskey plant, Mr. John stated, is the best of any of the nine plants under his management and it had the best showing of any for 1931. A considerable factor in this showing, he added, is the plan now in use of shipping cement by boat in bulk to the storage plants in Chicago, Milwaukee and Detroit. This plan was placed in operation three years ago at the insistence of John L. A. Galster, treasurer and general manager.

Push but on stations for momentary and maintained contact in the control of electrical equipment.



Announcing THE NEW CEDAR RAPIDS

-336-

HEAVY DUTY REDUCTION CRUSHER

Increased production at a minimum cost, is the problem of all material producers today. The "New Heavy Duty 'Cedar Rapids' 336 Reduction Crusher" is solving this problem for both the stationary and portable plant operators. Double your daily capacity by adding one or more Cedar Rapids Reduction Crushers to your plant equipment. In the "Cedar Rapids' Line" you will find equipment to solve your material handling problem. Write us today for our special 336 circular and also a copy of our general catalogue.

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Cedar Rapids, Iowa



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Are you taking full advantage of it? The tariff and exchange are probably making it difficult for you to secure Canadian business. Why not arrange to have us make your equipment for your Canadian Market instead of building your own plant in Canada. We can make you an attractive proposition involving a Low Overhead, Cheap Power and Reasonably Priced Labor.

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